PUBLIC WORKS

An Engineering and Construction Journal

City County State

VOL. 62 SEPTEMBER, 1931 NO. 9

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Over, Under, Around or Through

When we talk of engineers, we have in mind the technical man, whether he be city or county engineer, water works superintendent, or just plain engineer. It makes no difference whether or not he has a technical degree. It is not technical knowledge only that makes an engineer, in the full sense of the word, but honesty and integrity, backbone and vision, resourcefulness and knowledge of human nature and materials.

Despite his many advantages, however, the average engineer too often hesitates to accept responsibility outside of the narrow field of design and cinstruction. He steps aside for others less well fitted to conceive and plan, to initiate and develop. He is too content to let another, less well trained and able, to act as leader. And, also, he is too prone to get into that frame of mind that is reflected by the thought: "Gosh, if I ever lost this job, I don't know where I'd get another as good."

It is easy to criticize this attitude, especially when one is not* in the same condition. Yet it is equally easy to map the path that brings a man finally to that state of mind. With this trail mapped so plainly, every effort should be made to avoid it.

Let the engineer recognize that his knowledge and experience confer upon him certain responsibilities that he cannot well shirk. It is his duty to employ his knowledge and ability to the utmost. That much he owes to the community. For instance, when a man becomes a captain in the army, he must assume certain duties and responsibilities; when he is promoted to a majority, there are added responsibilities which he must accept; and so on up the line. These responsibilities cannot be shirked; they cannot be delegated. They must be met.

Life is the same, whether in an army or elsewhere. An obstacle to a man so well equipped as the average engineer should be but an added incentive; it should kindle a determination to overcome it. And we all might remember the parable of the talents, and ponder our obligation in the light of that.

* For the moment.

Congratulations, N. E. W. W. A.

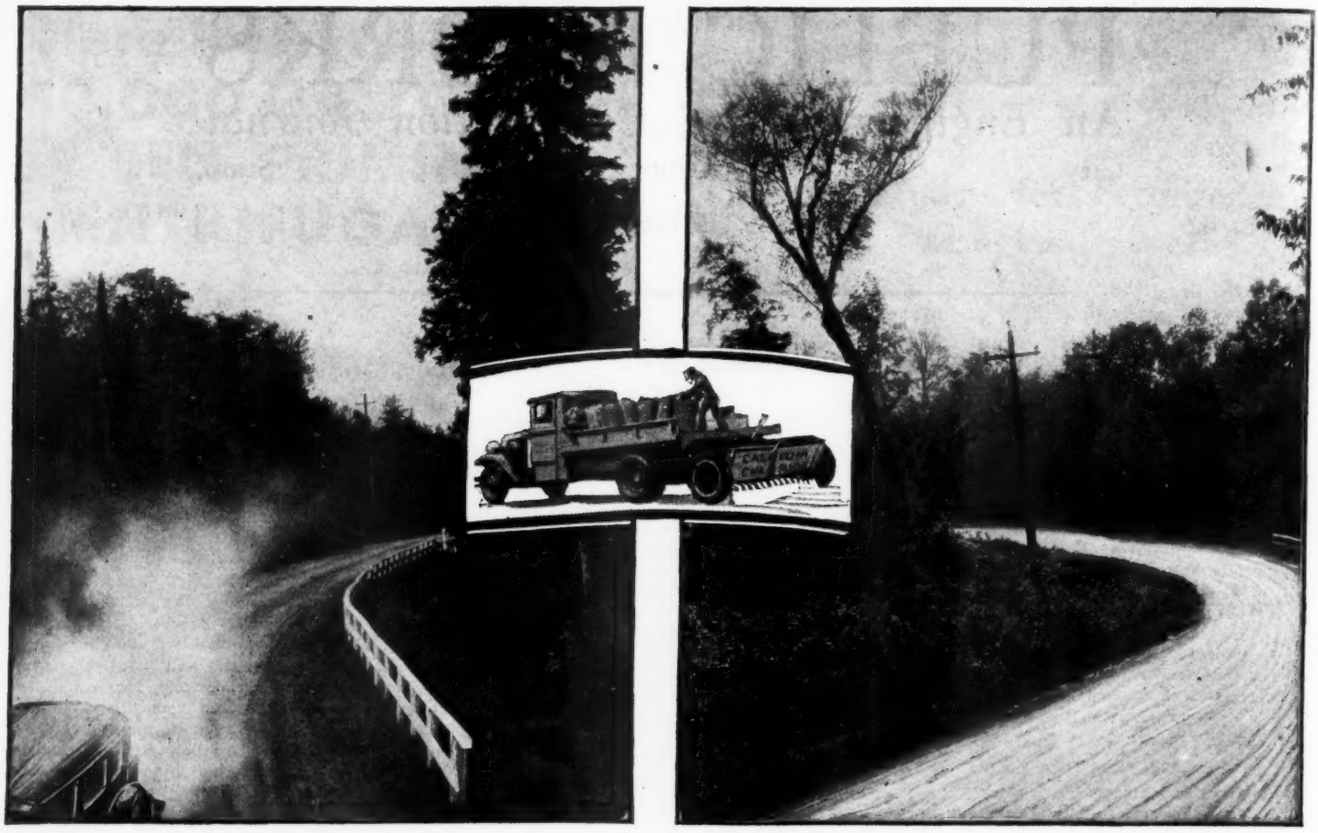
Organized in Boston June 21, 1882, the New England Water Works Association holds, the end of this month, its fiftieth annual convention. PUBLIC WORKS offers its heartiest congratulations to the Association for its outstanding record of service over this long period of time. Best wishes, N. E. W. W. A.; and may your next fifty years be as successful.

J. T. MORRIS, *President*
W. A. HARDENBERGH, *Vice-Pres. & Asso. Editor*
CROXTON MORRIS, *Ass't Manager*

PUBLIC WORKS
Founded in 1896
A. PRESCOTT FOLWELL, *Editor*
Published Monthly
at 310 East 45th St., New York, N. Y.
Western Office: 122 South Michigan Ave., Chicago

SUMNER N. HUME, *New York, N. Y.*
JOSEPH E. O'CONNOR, *Chicago, Ill.*

SUBSCRIPTION RATES: United States and Possessions, Mexico and Cuba...$3.00 Canada . $4.60 All other countries.. $4.00 Single copies, 35 cts. each



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PUBLIC WORKS

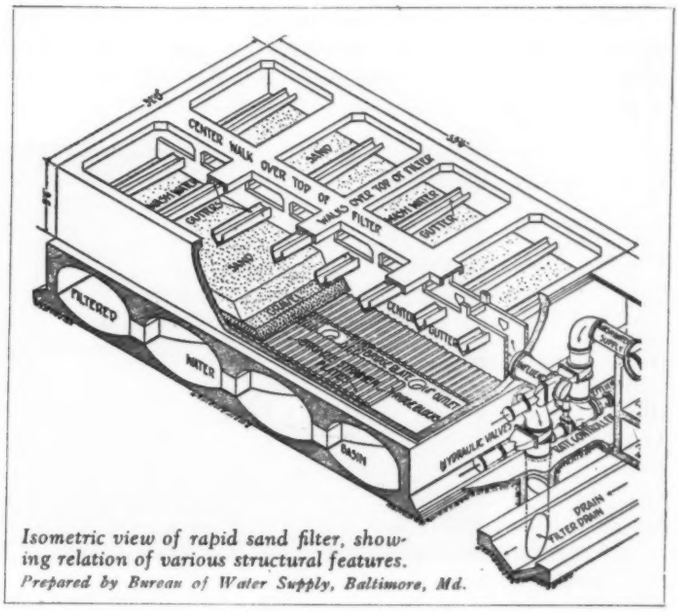
CITY COUNTY STATE

AN ENGINEERING AND CONSTRUCTION MONTHLY

Vol. 62 September, 1931 No. 9

The first four articles of this issue have been written by the editorial staff of PUBLIC WORKS *expressly for non-technical municipal officials, with the purpose of giving a general brief summary of present practices, and the fundamental theories upon which they are based, in designing and operating plants for purifying water and treating sewage, in constructing and maintaining street surfaces, and in collecting and disposing of municipal refuse. A reading of these will, it is hoped, give such officials a general idea of these branches of municipal housekeeping, not with the idea that they can then design or operate them themselves—this should always be delegated to experts in these lines—but that they may more intelligently administer the departments having these matters in charge.*

The Why and How of Water Purification

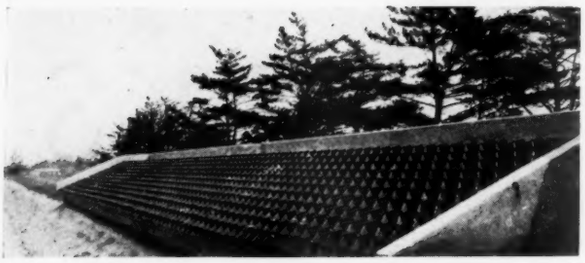


Isometric view of rapid sand filter, showing relation of various structural features.
Prepared by Bureau of Water Supply, Baltimore, Md.

TO be satisfactory, a water supply for a community must be entirely free from pathogenic or disease-producing bacteria, and reasonably free from any bacteria; and it must be suitable in regard to taste, odor, color, turbidity and hardness. With present-day water purification processes, these desirable characteristics can be secured, almost irrespective of the quality of the original water. In nature, there are few waters that meet all these requirements, and purification is necessary to a greater or less degree, depending upon local conditions. The cost of purification is small, considering the many advantages accruing to a community from a safe and satisfactory supply.

Economics of Water Purification

Health.—Based upon the decrease in deaths and sickness alone, and neglecting the inconvenience and suffering that may be caused by such sickness, purification is often a paying investment. Increasing density of population and the practical impossibility of thoroughly safeguarding a watershed usually make it necessary to provide some sort of treatment. The long list of epidemics of water-borne diseases, such as typhoid fever, proves that the possibility of contamination is never absent. The liability of a municipality for typhoid contracted through an improperly protected water supply has been definitely fixed by a number of legal decisions.



Aerator at New Brunswick.

Coagulating basins, Columbus.

Hardness.—When water contains more than the usual amount of hardness, it is economical to soften it. Usually it costs far less for a municipality or community to soften the water than it does for the individual to do it himself. This was discussed in an article in PUBLIC WORKS for December, 1930, in which it was shown that an average family in Columbus, O., saved about $50 per year by municipal softening.

Other Factors.—If the water has a disagreeable taste or odor, which may happen even in perfectly safe supplies during certain periods of the year, many citizens will buy bottled water, at a considerable cost, or may use local wells or cisterns which are unsafe. The feeling of dissatisfaction caused by tastes, odors, or even color in the water, is often reflected by a turnover at the next election.

Methods of Purification

Purification of a water may include any or all of the following: Settling or sedimentation, coagulation with chemicals and settling, filtration through beds of sand, aeration, and chlorination. If the water is clear, and without taste and odor, chlorination only may be needed. If it carries considerable color or turbidity, filters with preliminary settling may be required to make it safe and attractive in appearance.

Interior view of filter house, Nashville water works.

Sedimentation consists in allowing the water to stand in or flow slowly through tanks or other storage basins or reservoirs. The larger particles in the water settle to the bottom, but the finer particles of clay and silt are not appreciably affected by sedimentation. Prolonged storage in large reservoirs has a beneficial effect upon the quality of the water but does not make it safe to use. A detention period of 8 or 10 hours is generally sufficient for the removal of the larger particles; those which would not settle in that time can be removed more economically otherwise.

Coagulation.—Water which contains organic matter or other substances in solution or as colloids (very finely divided particles) cannot be satisfactorily treated by sedimentation alone. But by adding coagulants to the water, such as compounds of alum or iron, a light, jelly-like precipitate, called *floc*, is formed, which settles slowly to the bottom carrying with it much of the fine suspended matter and colloids and many of the bacteria in the water. A small amount only of the chemical is required for ordinary treatment of the water, and the cost is small. Coagulation and removal of the floc by settlement makes it easier for filters to produce a clear and sparkling water.

Coagulation is not required for waters that are clear, but only for those that are turbid and muddy. It is not used alone, but is always a preliminary and preparatory treatment to filtration.

The chemicals may be fed dry, or in a solution. Usually the dosage is accurately regulated by a machine which may adjust the amount of chemical to the flow of the water. After the chemical has been added, the water is agitated to secure thorough mixing, either by a mixer or by passing it through a baffled channel.

After the admixture of the chemical, the treated water is allowed to flow slowly through a specially designed tank which allows a settling period of 3 to 6 hours. During this period the floc forms and a large part of it settles out, carrying with it a very large part of the suspended matter in the water, thus relieving the filters of much of the load.

Filtration.—Water thus coagulated and settled, or without this treatment if naturally clear, is passed through beds of sand about 30 inches thick. That portion of the floc which did not settle out is caught on top of the sand bed and forms a very effective strainer or mat, which removes, in conjunction with the sand grains of the filter, the remaining suspended matter in the water.

(Continued on page 60)

Appearance of finished asphaltic gravel surface.

Street Improvements in a Small City

Except in the business district and main highways, dustless low-cost streets of the better kind will generally suffice. Through-traffic streets should be built and maintained by county or state.

THE streets of a small city or town may be divided roughly into three classes: 1—Those which carry, or need to carry, little but residence traffic. 2—Business and main traffic streets. 3—Streets that carry through traffic, being parts of a highway that passes through the town.

The first two blend more or less gradually into each other along the borders of the business center, the second class replacing the first a block at a time as the town and its business center grow.

Through-Traffic Streets

The third class will be considered first, as they can be dismissed with two or three paragraphs. As they are really parts of a main highway they should have the same kind of pavement as that highway, and of the same width plus such additional width as may be needed for local purposes. If, as is too often the case, these streets are also the main streets of the town, the additional width should be sufficient to allow for parking, plus at least one lane of moving traffic, on each side of the street. If this additional width is not provided, parking in front of stores on this street is difficult and the through traffic is interfered with.

These streets should be, and commonly are, paved and maintained by the county or state, at least for the width which is given to the highway outside the town. It is more or less common practice for the town to pay the county or state for paving the additional width with the same material and at the same time it paves the highway. In this way it generally can get a high-grade pavement for what it would otherwise pay for a lower grade one.

If the highway is not a main thoroughfare of the town, the additional width is still necessary, but not the high-cost pavement. In fact, it may be more desirable to lay a low-cost pavement on each side of the highway pavement, and even to separate the two by a narrow strip of parking or a low curb, so as to discourage the speeding through traffic from endangering local traffic and parked cars.

Residence Streets

The great majority of the streets of a small city or town are used for residence purposes only, and need to carry only such traffic as is occasioned by the pleasure automobiles of the residents of such streets and their friends who call upon them, and the light cars which deliver milk, ice, groceries, etc., with an occasional heavier coal truck or moving van.

Such traffic, while it might be considered "heavy" for a country road, would be "light" for a city street or a through highway near a large city. For such streets, what are known as low-cost surfaces will generally suffice. Such surfaces, however, should be dustless; if made of gravel or stone, this involves bituminous surface treatment or else treatment with calcium chloride or other dust layer.

Which of the several kinds of low-cost road treatment is best for a given town depends chiefly on what materials are locally available. As a basic material, gravel is probably the most widespeard of the satisfactory materials; and stone, to be crushed for use, is second in availability. Where neither of these can be had at reasonable cost, so-called "sand-clay" or "top soil" material may be available and give satisfactory results if properly treated; or a sand-asphalt mixture may be used where clay is not available.

Another consideration of great importance is the climate. Where there is little or no rainfall, especial attention must be given to the binder. Clay is of little use in a very dry country, for once a clay bond is broken (which occurs easily in dry clay) it not only is not renewed until the clay is wet, but the clay pulverizes and is blown away. Then the gravel or broken stone, free to move under traffic, grinds to dust, and this also (which would form additional

binder in a moist climate) blows away. In fact, so considerable is this attrition in the case of gravel roads in dry desert country that the surfaces of such roads are lowered a measurable amount each year by the blowing away of pulverized particles. Apparently the only satisfactory binder under such conditions is either a bituminous one or portland cement.

On the other hand, too much moisture calls for special considerations of other kinds. If it occurs in the form of rain, and the streets are at all steep, clay binder is apt to be washed out in spots and streaks, the gravel or stone so loosened is removed by water or traffic, and gulleys and pot holes are formed. Here again the remedy is portland cement or bituminous binder; or brick, if it is not too expensive.

If there is excess moisture in the soil, the only permanent satisfactory remedy is drainage; although a portland cement concrete or "black base" (bituminous concrete) may serve as a substitute if conditions are not very bad. Where the entire area is low and swampy, the only real remedy is thorough drainage, generally accompanied by elevating the street by at least two feet of embankment. (Of course, a town ought not to be located on such soil in the first place; but in some parts of the country more desirable locations are not available.)

Wide main street in Columbia, Mo. Paved with brick.

Mixed in place Tarvia B prime on native sand in 1928. Resealed in August, 1930, with Mex Pet Surfaseal No. 2 and covered with 20 pounds of ¾" to ¼" granite chips, and rolled with 3½ ton roller. Roadway 15 feet wide, 2" x 4" wooden headers along sides staked every 4 feet.

After a street has been trenched for sewers and water mains, such trenches serve as "blind drains" and there is usually little trouble afterward from wet soil under the pavement. It may be best, therefore, not to spend too much on sub-drainage, but to lay sewers and water mains in the street as soon as possible, and construct only a temporary cheap road surface until that has been done.

There are so many conditions of climate and traffic under which clay binder, at least on the top surface of the roadway, is unsatisfactory and so few where it is satisfactory that its use has been all but abandoned on streets, and bituminous materials have come into common use in its place. These are combined with gravel, broken stone or sand in a number of ways, many of which have proven at least fairly satisfactory when carried out intelligently and thoroughly by men experienced in the method employed. Among these are various mixed-in-place methods (bitumen applied after the stone has been spread on the road and then mixed with it by harrows, etc.), using light oil, or tar, or cut-back asphalt or asphalt emulsion; plant-mixed treatment, in which the bituminous material and stone, gravel or sand are mixed in a machine before being spread on the road; and surface treatment of a pavement which has already been compacted, generally by traffic. There are a number of variations of each of these methods, some caused by the nature of the local materials or the climate, some by the ideas of the men in charge of the work; and some differing slightly except in the name applied to them. (See the following articles in PUBLIC WORKS: "Maine Surface Treatment Methods" (gravel roads), Aug. 1931; "Surface Treatment Methods," Aug. and July; "Bituminous Surface Treatment at Low Cost," June; "Construction of a Low-Cost Pavement in Grass Valley, Calif.," May; "Bituminous Surface Treatment Methods," May; "Dane County's Eight Years' Experience with Low Cost Road Methods," February; "Development of Sand-Asphalt Roads," January; "Low-Cost Residence Streets," January; "Present Trends in City Paving," December, 1930; "Changing a Gravel Road to Asphaltic Gravel," November.)

Dirt and clay-bound roads suffered from standing water and could not be kept or even made very smooth so it was necessary to crown them considerably to drain the water to the gutters. With bituminous surfacing or concrete a low crown is ample, and a high one is objectionable to automobile owners, whether traveling or parked at the curb. Therefore high crowns should be cut down to not over two or three inches when a street is given a modern smooth, waterproof surface.

Horses no longer paw out holes in front of hitching posts, and special paving in gutters for this reason is not now necessary; but generally any water-proof surface is good enough for the gutter if good enough for the rest of the street. On the other hand, a dirt surface left for parking between the pavement and the curb causes dirt to be tracked onto the central pavement, and during rains becomes soft if on a flat grade and is washed out if on a steep one. It would seem to follow that when the surface of a street

(Continued on page 72)

Sewage Treatment for the Smaller Community

A small, complete sewage treatment plant.

PROGRESS in the science of sewage treatment during the past few years has made it possible for even the small community, at a relatively reasonable cost, to dispose of its sewage without creating a nuisance. With the development of these newer methods, there has come a corresponding need for better operation, which is being met by improved training facilities for sewage plant operators, and a greater appreciation on the part of municipal officials of the necessity for all-year sewage plant operation of a high grade.

There is no hard and fast rule as to the degree of treatment that must be given sewage. While it is possible, by use of present-day treatment methods, to turn sewage into drinking water (see page 488, PUBLIC WORKS, December, 1928) it is rarely, if ever, necessary for a community to do this. Generally only so much treatment is required as will prevent nuisance and spread of disease. The degree of treatment, therefore, will vary from place to place. One community, located on a small stream directly above other thickly populated localities, will be required to give much more complete treatment to its wastes than will another that may be located on a larger stream a considerable distance from any other city or village.

The recognition of this fact, coupled with the development of new and cheaper methods of treatment, has made it possible for many communities to construct sewage treatment plants without serious strain on their finances.

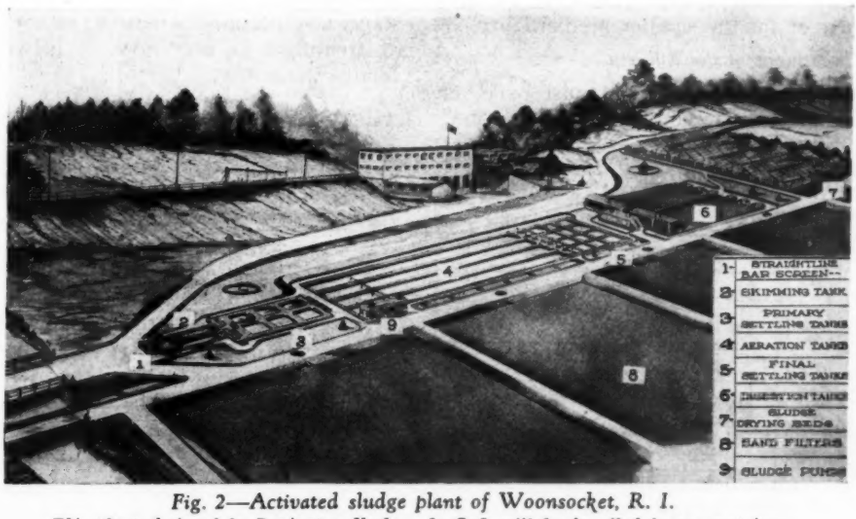


Fig. 2—Activated sludge plant of Woonsocket, R. I.
This plant, designed by Remington, Vosbury & Goff, will be described in our next issue.

During the past three or four years, there have been rapid developments in treatment of sewage by chlorination, by the sedimentation and separate sludge digestion process, and by activated sludge. In many cases it is possible to substitute chlorination for more expensive filters or contact beds formerly considered necessary; and the separate sludge digestion process has enabled the construction of modern-type plants, producing a good effluent at a low cost and with little danger of odor production. The activated sludge process has been developed to a point where very complete treatment can be given to sewage at a reasonable cost.

Basis of Treatment Methods

As a rule, the solid matter in sewage does not exceed 1 or 2 parts in a thousand, and most of the methods of sewage treatment involve preliminary separation of this solid matter from the remainder of the sewage. In *tank* treatment, this is done by allowing the sewage to flow slowly through a tank, during which period a considerable part of the solid matter settles to the bottom as *sludge*. The partly purified sewage, called *effluent*, flows on out of the tank, and is given such further treatment as is required by local conditions. In many of the newer plants, treatment of this effluent by *chlorination* is sufficient; in other places it may be necessary to pass it through *sand filters* or to spray it over *trickling filters*. The sludge should be removed daily or continuously from the settling tanks into specially constructed *sludge digestion tanks*, where it is stored for several weeks or months, during which time it is digested by bacterial action and changes into a relatively unobjectionable form. This digested sludge is then dried, preferably on sand beds covered with *glass enclosures*, similar to those used for greenhouses, which protect it from rain and other unfavorable weather conditions and permit a regular drying schedule to be maintained. When dried, the sludge may be used for fertilizer, as it contains some elements of value for this purpose and in a number of places is sold, bringing a small return to the community.

Tank Treatment

The old type of *septic tank* is no longer considered suitable for treating the sewage of large communities. The degree of treatment is not very great, odors may be produced, and the cost of removing the sludge two or three times a year may be considerable, not to mention the disagreeable character of the work.

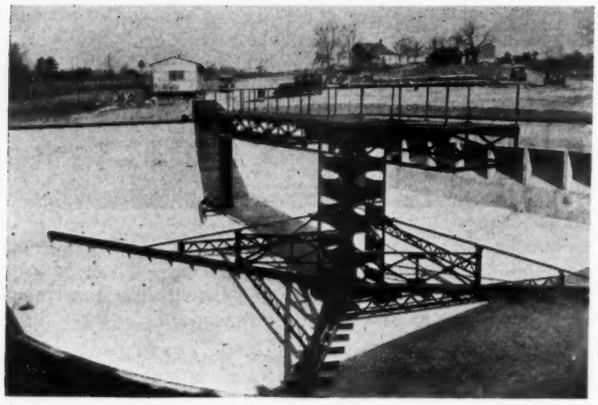


Fig. 3—Sludge mechanism in a square tank.

Modern methods of tank treatment include *plain sedimentation*, with separate sludge digestion, and *Imhoff* tanks. In the former, the tanks are preferably constructed with mechanical sludge removal equipment built in place, these being generally either the Link-Belt, shown in Fig. 4, which is designed for rectangular tanks, or the Dorr, shown in Fig. 3, which is designed for use with round or square tanks. These devices eliminate the costly and disagreeable job of tank cleaning, and allow daily removal of the sludge. With their use, and with tanks of latest design, about four times as much sewage can be treated as in septic tanks of the same size, and with better results.

Imhoff tanks operate on much the same principle as do the sedimentation and separate sludge digestion tanks just described, but the settling and digestion tanks are built one above the other. These tanks have given excellent results in operation, but in many instances the separate digestion type of tank will be found cheaper for the smaller municipality.

Treatment of the Effluent

Where a high degree of treatment must be given the effluent, this may be accomplished by spraying it over a stone bed, through which it slowly trickles. This is called a *sprinkling* or *trickling* filter. Such treatment results in a clear effluent, which will not decompose further under usual conditions. The cost of such construction, however, is quite considerable, usually about one-half the total cost of the plant.

Contact beds, still found in some older plants, are not economical under present-day conditions, as they cost more than trickling filters for the same capacity, and do not yield as good an effluent. *Sand beds*, used chiefly in the New England states, are still more costly, and are limited in the amount of sewage that they can treat per acre; the effluents produced, however, are generally better than by any other process in common use.

Chlorination has been employed with much success in many places as a substitute for filters. (See the description of the Liberty, N. Y., plant in this issue). It has many limitations, however, and can not be used under all conditions.

Activated Sludge Treatment

This is one of the most recently developed sewage treatment methods. In general, it consists of passing the sewage through specially constructed tanks, meanwhile subjecting it to aeration, either by blowing compressed air through it, or by mechanical agitation and allowing the absorption of oxygen from the atmosphere, or by a combination of both methods. Fig. 2 illustrates a recent activated sludge plant.

The results attained by this method are excellent, and the sewage may be discharged without nuisance into almost any stream, even a small one. The sludge, though of great volume and difficult to dry, possesses unusual value as a fertilizer.

The principal disadvantages are the comparatively high first cost, and the cost of operation; but rapid progress is being made in reducing these, and the advantages of this method are such that in many instances, especially where a rather complete degree of treatment is necessary, it is well suited for the small community.

Final Disposal

The liquid portion of the sewage, whether treated by trickling or sand filters, chlorinated, or given no treatment at all, must eventually find its way into a watercourse, and the ultimate disposal is always by dilution. The volume of water flowing in the stream that receives it, its oxygen content, and other factors that must be evaluated by the engineer, determine the degree of treatment which must be given the sewage.

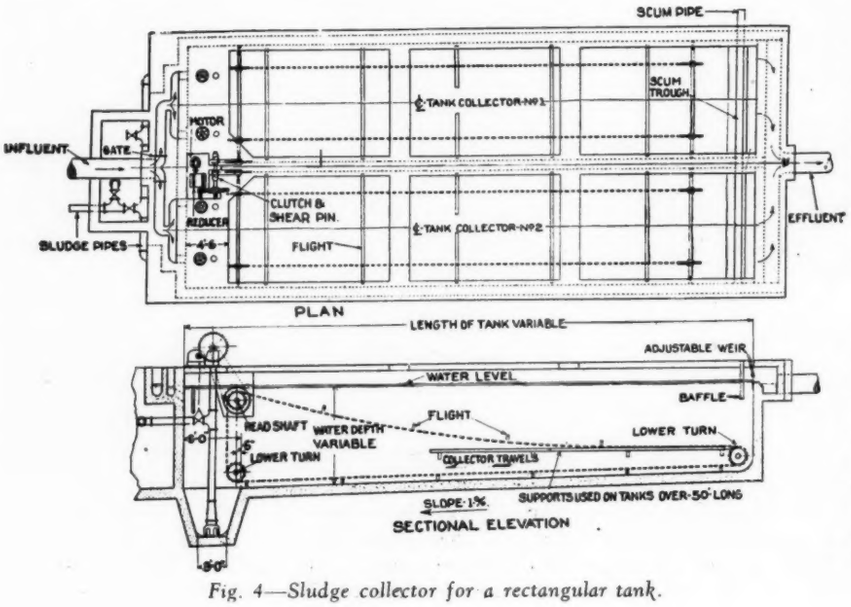


Fig. 4—Sludge collector for a rectangular tank.

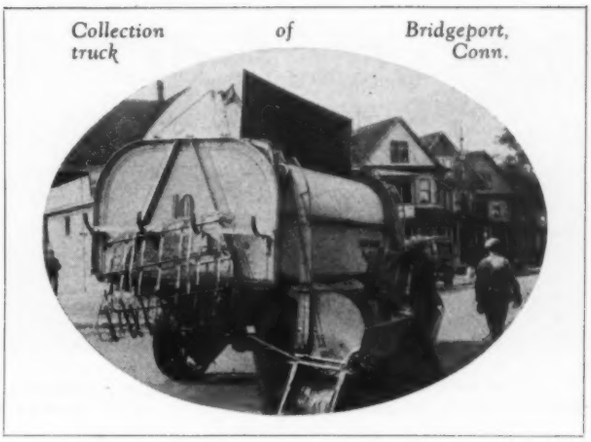
Treatment of the Sludge

The solid matter removed by tanks can not well be discharged into a stream, for it would form sludge banks, and cause nuisance. Therefore, after digestion in separate sludge digestion tanks or in the lower chambers of Imhoff tanks, or after treatment in activated sludge plants, it is dried, gen-

(Continued on page 56)

Refuse Collection and Disposal

How much garbage, ashes and rubbish to expect, methods and equipment employed in collecting it, and how it can best be disposed of without creating a nuisance.



Collection truck of Bridgeport, Conn.

THE solid wastes of a community consist of garbage, rubbish, ashes, manure and other materials no longer of use or value to the community. It is necessary so to remove and dispose of these as to prevent nuisance, with due attention to economy, cleanliness and health.

The relation of these wastes to health is indirect. While the presence of uncollected garbage is most disagreeable, and while piles of ashes and rubbish are objectionable from the aesthetic viewpoint, the direct effect upon the health of the community is relatively slight. Indirectly, though, garbage, by furnishing breeding places and food for flies, rats and other insects and vermin, and manure by producing countless thousands of flies, may have a tremendous effect upon disease prevalence. In fact, flies are among the principal agents in the transference of typhoid fever, colitis, dysentery and allied diseases. The odors from decomposing garbage physically affects many people.

Garbage consists principally of the waste and refuse resulting from the preparation, cooking and consumption of food, and includes, also, spoiled and decayed vegetables, meats, etc. It is composed very largely of organic matter and decomposes rapidly, creating disagreeable odors. *Rubbish* is the term used to designate a wide variety of waste materials such as paper, rags, old clothes, straw, excelsior, rubber tires, old and broken furniture, bedding, tin cans, etc., which are generally non-putrescible, and do not attract objectionable insects and animals. *Ashes* is the residue resulting from the operation of heating plants in homes, schools, churches, stores, etc. (Those from manufacturing or industrial plants are not usually considered a municipal responsibility.) *Other wastes* may include manure from stables, street sweepings, dead animals, and trade wastes generally.

Quantity of Wastes

While the quantities of these wastes vary largely with the locality, character of the inhabitants, season, geographical location and other factors, there will ordinarily be collected from 1,200 to 1,700 pounds of waste per person per year. The amount per person of garbage has been increasing for some years, but probably decreased during the past year. It may be estimated at approximately 200 pounds per person per year, or slightly over one-half pound per person per day. This will vary seasonally, production during the summer months being perhaps as much as one pound per person per day. The maximum usually occurs in August or September.

The average amount of rubbish, which is comparatively light in weight and large in volume, is around 100 pounds per person per year. The production is rather uniform throughout the year. The volume of ashes depends upon the geographical location, as north or south. In the colder areas the amount may exceed 1,500 pounds per person per year, while in southern sections there may be so little ashes produced as to require no collection service. The amount of manure per horse or cow, including bedding, is around 30 pounds per animal per day. Dead animals may provide somewhat of a problem during the summer months.

Containers for Refuse

Householders should be required to place their garbage in containers that are watertight, of impervious materials, provided with a tight-fitting cover, and constructed so as to allow easy and thorough cleaning. Galvanized iron cans of 9 to 15 gallons capacity are suitable. For refuse, barrels or boxes may be employed, which should be covered to prevent spillage or the blowing about of paper or other materials. Ash containers should be covered, and of a non-combustible material; the weight filled should not exceed 150 pounds.

The *collection* of the receptacles may be from the curb line, the alley line, or the back door. Each has its advantages. Where alleys are open, this is generally the most desirable location, but in most communities collection is from the back door. The *house treatment* of refuse is important, especially where garbage is fed to hogs, in which case the householder must store the edible portions of the waste in a separate container. Likewise, separation is necessary where the garbage is collected more frequently than the non-putrescible materials, and also where it is more economical to dispose of the garbage separately from the other wastes. This is a matter depending upon local methods of final disposal.

Collection of Refuse

Frequency—To prevent nuisance, garbage must be collected at least twice a week in summer, and three times a week is better; daily collections are employed in a number of places, but are generally not practicable for the smaller community. Rubbish and ashes need be collected only with sufficient frequency to prevent too large accumulations. During winter,

Though it utilizes some of the values in garbage, feeding it to pigs is likely to produce intolerable nuisance unless great care is observed.

ashes should be collected at least once, and preferaby twice a week. Rubbish may be collected once a week or once in two weeks. It is cheaper, and usually better where the disposal methods allow, to collect all waste at one time, as this saves a number of trips, and gives the householder better service.

While in some places it is the practice to collect wastes at night, daytime collection is generally preferable.

Methods of collection vary. In some of the smaller communities, only garbage is collected by municipal agents, leaving to the householder the problem of disposing of ashes and rubbish. It is better, however, for the community to take the entire responsibility for collection of all wastes.

Agencies of collection may be licensed scavengers, a contractor, or municipal forces. The last is always the most satisfactory.

Charges for collection should be included in taxes; if householders are permitted to neglect or refuse to pay the scavenger, the lawabiding portion of the population suffers from the nuisance created by uncollected or improperly disposed of refuse. In some places, the scavenger cannot collect more than 75% of the fees due him, and he naturally discontinues removal of garbage from the homes not paying.

By operating the collection service as a municipal undertaking, including the charge for refuse collection in the taxes, the municipality is almost always able to collect the refuse at a less cost than the charges made by licensed scavengers, while giving better and more sanitary service.

Equipment for Collection

For *garbage* collection, vehicles should be tight, to prevent leakage; with bodies of impervious materials, and construction details such as to facilitate cleaning and of a size suitable for the amount to be collected. For smaller communities, 1½-ton units are suitable and economical. The sides should be low to make loading easier. They should be covered, to minimize odors. (Canvas covers are not satisfactory.) Collection vehicles of the type shown on page 21 are found to be satisfactory. These are suitable for the collection of mixed refuse, as well as for garbage.

Management of Collection

The collection of refuse presents a very difficult problem. It is almost invariably the source of numerous complaints, many of them unfounded. Even under the best operating conditions, there will be some spillage or leakage of garbage, and some lapses in the collection schedule. But with modern, covered, collection vehicles; with a collection system operated under the direct control of the municipal officials; with 100% collection of fees, assured through payment of such fees as taxes; and with proper disposal of refuse, justifiable complaints can be reduced to a minimum and a service performed that will be appreciated by the public, and will reflect credit upon the municipal official responsible. An article in the December, 1930, issue of PUBLIC WORKS described the experience of Bridgeport, Conn., where modern equipment and good service resulted in an almost total absence of complaints in that city of 150,000 people.

Proper Refuse Disposal

It is necessary to differentiate between *disposal* and *proper* disposal. The mere placing of refuse including garbage on a dump always results in a nuisance and the production of flies and other vermin and is not a satisfactory, sanitary or proper method of disposal (though it is used extensively) unless the dump can be located far enough from any habitation. But flies travel many miles, and on a still evening odors may be objectionable more than a mile away; and if the dump is located far enough distant to be unobjectionable, the cost of the extra haul to it may become a serious matter.

When *dumping* is used, to minimize the nuisance depositing of fresh material should be concentrated along a narrow edge, rather than

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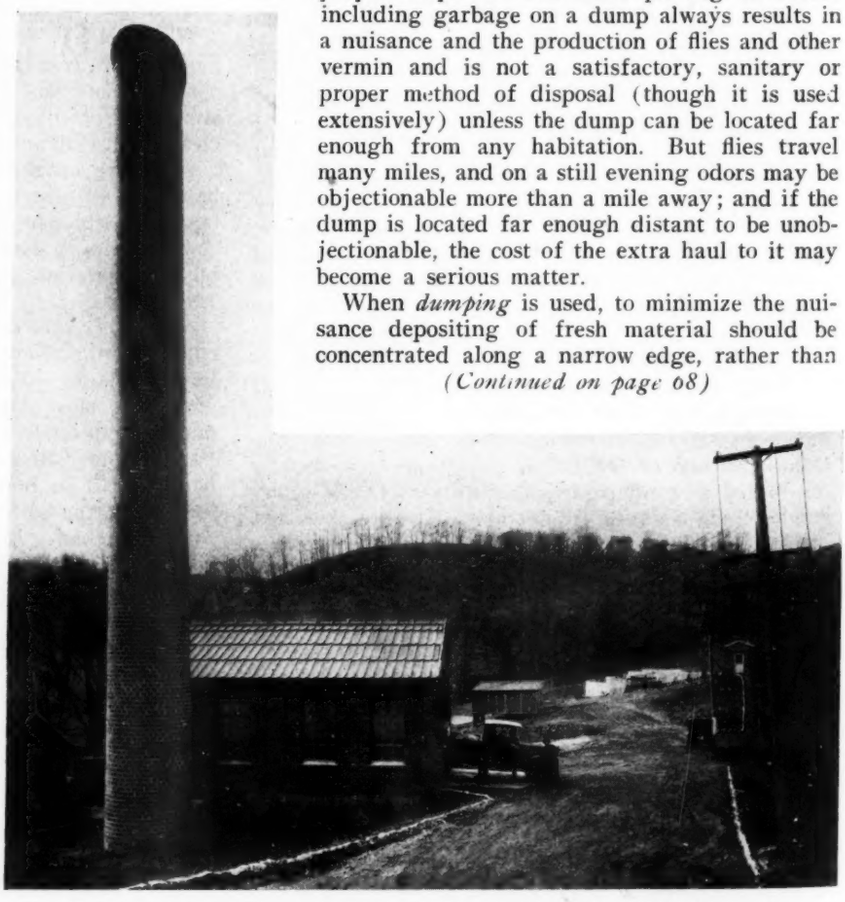


Ft. Thomas, Kentucky, incinerator; sewage treatment plant in background

Mechanical Equipment in Accounting

By M. F. Hoffman

Assistant Superintendent, Commercial Division of the Department of Water Works, Cincinnati, Ohio

MECHANICAL devices have been developed for almost every step in accounting, and the intelligent use of these machines, together with the new methods of accounting, have provided a means for the effective handling of a greatly increased volume of work.

Municipal government, however, has not kept pace with these improvements, despite the fact that municipal activities are constantly increasing and expanding. Operating expenses have been cut in order to meet decreased revenue and to assist in unemployment relief, but many cities will need to make still further reductions. Cities use motor trucks, steam shovels, cranes, electric drills, and much other modern equipment, but since most cities are without accurate operating cost records, a true picture of the amount and cost of the work done is not available for the chief administrator. The trouble lies in the fact that clerical and accounting methods have not been revised and modernized to meet the demands of increased activity.

The use of mechanical devices makes possible the centralization of accounting work, the prompt billing of taxes, and the preparation of complete daily financial reports. The method of selecting and installing the necessary mechanical devices for such work is described in the following article.

Before an attempt is made to change the accounting system in use in a given city, a complete study should be made of all operations. This study should answer such questions as:

(1) Is the work now being done satisfactorily? If not, why?
(2) Does the fault lie in the worker or is it in the operation?
(3) In what manner is it unsatisfactory?
(4) How much of a factor is time in this operation?
(5) What does it cost to do the work?
(6) Can improvement be shown in the operation through manual performance?
(7) Is any advantage to be gained by having the work done by machines?

If the investigation indicates that mechanical devices would be practicable, the next problem is the selection of the proper machine—a difficult task because of the flexibility of most mechanical devices. Salesmen, generally biased in favor of their own equipment, will show the application of their machines to a particular operation. In making a selection, therefore, mechanical devices should be studied with the following points in mind: (1) increase in production; (2) accuracy; (3) speed, simplicity and flexibility of operation; (4) amount of investment; (5) operating cost for first year, and (6) operating cost for following year.

The obvious reason for having the operating costs for the first two years is that the second year should show a decrease in personnel provided a successful installation is completed.

In the remainder of this article the writer will describe the method followed in installing a centralized accounting system in the office of the city auditor in Cincinnati and in revising the method of billing, collecting, and accounting for taxes in the offices of the county auditor and county treasurer of Hamilton County, Ohio.

Centralized Accounting System in Cincinnati

Prior to the installation of a mechanical accounting system in the city auditor's office in Cincinnati, this office had three application ledger clerks, one incumbrance ledger clerk, one expense distribution ledger clerk, and one warrant distribution ledger clerk. In addition, each of nineteen city departments had individual bookkeepers who usually balanced their accounts between the tenth and fifteenth of the subsequent month and then checked with the auditor's books.

The revision of this work resulted in replacing the six clerks in the auditor's office with mechanical equipment and one supervisor. This centralization of accounting work led sixteen of the nineteen departments to eliminate their bookkeepers; the three departments continuing their own bookkeeping work represent the independent boards—water works, hospital, and park boards—where separate and complete sets of accounts are required.

All orders, whether for services, commodities, or any other expenditure, are prepared in the purchasing department upon receipt of a requisition properly approved by the department. The usual procedure is followed in inviting competitive bids and awarding the order to the lowest and best bidder. Five copies of all orders issued during the day are sent, before 3:00 P. M., to the auditor's office for certification. The original is sent to the vendor, the auditor retains the second copy, the third copy is sent to the requisitioner, and the fourth and fifth copies remain in the purchasing department.

The auditor then has a card punched showing the certification against the appropriation and a summary of these certificates is compiled on a tabulating machine to show the total amount of incumbrances daily.

After the order has been completed and a claim voucher rendered for the amount due, upon proper approval by the department head the voucher is referred to the auditor for payment. It is checked as to accuracy and discount and filed by date of payment. On the due date, a tabulating machine card is punched to show the liquidation of the previous certification or incumbrance, while checks are written on

duplicate warrant sheets by means of a typewriter with an adding attachment. The total of the checks on the warrant sheet comprises the day's total of disbursements, which is proven through a double tabulation of the cards: (*a*) by listing the cards in check number order, providing a cash disbursement journal record, and (*b*) by appropriation, activity, and object number of journal purposes.

At the beginning of the fiscal year a card is punched for each authorized appropriation. Each day these cards, together with those for the incumbrances, or certifications and liquidations, or expenditures are run off and, through the use of the complement method of tabulating, provide a daily statement of authorizations, expenditures, unexpended balances, incumbrances and unincumbered balances by activity and object. This statement is taken off by noon following the day's activities and affords a complete daily record of the city's financial operations for all departments, divisions, and bureaus.

The equipment of the auditor's office provides for each department a complete monthly report of its financial transactions, together with an annual statement, and complete financial statements for use in preparing the budget for the ensuing year. Further, it is possible at any time to analyze the city's finances in any manner desired. Owing to the close cooperation of the purchasing department, it is possible to ascertain how much the city spends toward any activity, any object or commodity, either as a whole or by departments. Near the close of the fiscal year, when departments are running close to authorized balances, the plan is vitally important, as the auditor, having each unincumbered balance available, is able to control all expenditures so as to not exceed the authorization.

Tabulating machines were selected only after a thorough study of the available equipment for a centralized accounting system. There is no doubt but that certain bookkeeping machines can perform certain parts of the procedure, but tabulating machines alone were found to be the only means which not only build up the accounting records but also offer facilities for making any distribution required for departmental needs. Under this system the auditor is truly the accounting officer for the city and he is enabled to provide a standardization of accounting operations for all departments thus assuring the maximum of success to this plan of mechanical accounting.

Billing, Collecting, and Accounting for Taxes in Hamilton County

Modern mechanical equipment also can be used to advantage in county offices. In the County of Hamilton, Ohio, tax bills including special assessments certified to the county auditor are mailed out semi-annually. In order to depict the changes being made in the county offices, a brief outline of operations is necessary to show the advantages of the new installation.

Under the old system three copies of tax rolls, showing the property owner, address, and description of property, were written on typewriters. The amount of taxes and special assessments was inserted by hand and totaled on adding machines. A duplicate copy of these tax rolls went to the treasurer, who prepared bills on billing typewriters by copying the information from the tax rolls to the tax bills. This cumbersome procedure made it almost impossible to complete the tax bills by the stautory date. An additional problem was the manual distribution of taxes after the completion of the tax collection period into taxing divisions and special assessment projects.

Upon the request of the county auditor and the county treasurer, a thorough study was made of the various steps in the procedure and the recommendations submitted are now being carried out. Typewriters have been replaced by an addressograph system giving a complete list of property owners and description of property. This system provides a complete method for preparing tax rolls, tax bills, field rolls, and assessment notices. Plates are revised daily in accordance with property transfers and other charges, so as to be accurate at all times.

Attention was then given to the accounting phase of this procedure. In Hamilton County tax billing is but one of the steps, as there are 159 taxing divisions and approximately 1,400 special assessment projects into which tax collections must be distributed. After considerable investigation it was found that tabulating machines alone would accomplish the necessary result. Tabulating cards, punched to identify the account, taxing district, valuation, tax rate, amount of taxes, special assessment, project number, amount of special assessment, kind of special assessment, year of tax and penalties, are used not only for compiling an abstract of valuation for the purpose of determining the tax rate but also for other purposes which will be mentioned later.

At present the county auditor's office is installing a printing automatic addressograph. A large roll of paper inserted in this machine will be printed, addressed, and perforated into individual bills. The tax rolls will be listed on smaller machines and tabulating machine cards also will be addressed. At the time of addressing, machine registered numbers will be recorded on the bill so as to tie in the tabulating cards and bills with the same number of the account on the tax roll.

Tabulating cards will then be used to complete the tax rolls and bills in the auditor's office, after which the treasurer will mail out the bills and receive the tabulating cards from the auditor for his collection period.

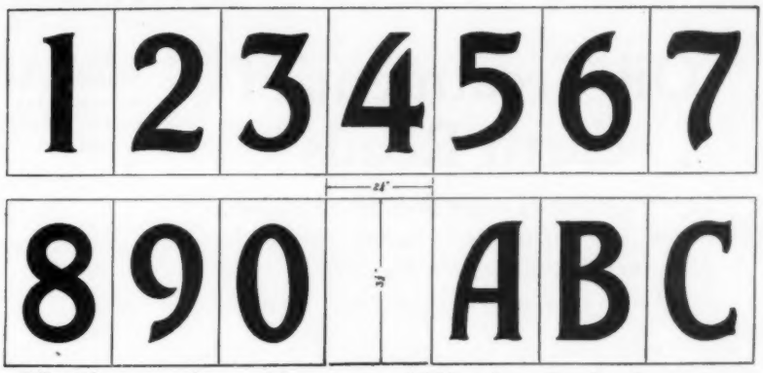
As collections proceed, the cashier's stubs will be used in removing the cards from the file and these cards will be used to balance the cashier's receipts. When this balance has been effected, the cards will be sorted into book and item number and remittance sheets printed on tabulating machines. The remittance sheets will then be used for posting to the tax duplicate, which is now comparable to a ledger, and the cards will be sorted as to general tax and special assessments, those for the former divided into taxing districts and recapitulated by the machine, thus providing a daily accumulation of paid general taxes by taxing divisions.

Under this new system, special assessments are to be sorted into project numbers and a total obtained for each project. Master cards will be punched for these amounts to expedite the distribution at the close of the tax collection period and also to provide for a complete daily distribution of the collections.

The cards which have not been removed from the

(Continued on page 68)

House Numbering Reform in Milwaukee



Official house numbers and letters, city of Milwaukee. One-fourth actual size.

UNTIL last summer the house numbers in Milwaukee were of little practical use—many houses had none, others were difficult to locate, and those in view were generally "so badly multilated or obliterated through wear and tear of the elements that they could not be read," says Joseph W. Nicholson in a monograph "House Number Signs" prepared for Municipal Administration Service. That has been remedied, however, and the details are described by Mr. Nicholson. An abstract of his description is given herewith.*

Every householder has been given a number plate, to which the city retains title, and is required to place it on a specified part of his building where it can most easily be seen, or incur a legal penalty and, after six months, refusal of the post office to deliver his mail.

The number signs were selected for visibility, durability and appearance rather than political endorsement, the preparation of specifications and purchasing being delegated to the Central Board of Purchases. The board first obtained, by advertising, samples of all types and descriptions made of tile, chrome-plated steel, porcelain enameled steel, and other materials, submitted by fifteen companies. Some were immediately discarded as obviously inferior; the others were subjected to exhaustive tests covering visibility, durability, appearance, fragility, absorption and susceptibility to temperature changes.

To test for visibility, the numbers were attached to a standard on a revolving base which was turned slowly, while a light was thrown on them at an angle similar to that from a street light, being meantime varied in intensity from zero to full voltage. The illustration shows the appearance at three different angles.

It was found that the colors for design and background giving the greatest visibility consisted of a black design on a light ivory background; ivory being preferred to white because, as the intensity of the light was diminished, the white became grey and then faded out completely, which the ivory did not do.

The style of digit adopted was evolved by the Milwaukee Chapter of the American Institute of Architects. Each member drew a design; and tests for sizes were made in a large laboratory where lighting and distance of observation were varied. It was found that the larger the background area within the digits proper, the sharper the visibility under poor light conditions. Final selection of design was made by a committee of this chapter, the superintendent of the Bureau of Electrical Service, and the purchasing agent. (The designs adopted, exactly one-fourth size, are shown herewith.)

Specifications were then adopted based on these tests, and bids asked for 550,000 digits and letters, accompanied by samples of the material the bidder proposed to furnish. The contract was let at 9 cents each, less 2% cash discount.

The specifications called for a background of tile or steel base with light ivory glazed surface; letters of the exact design and size specified, depressed 1/32" and jet black in color. If of steel, the face and edges were to be covered with at least two coats of light ivory vitrified enamel, and the back with a "sufficient number" of coats of vitrified material to protect against corrosion and rust; the steel being of at least 18 U. S. gauge. If of tile, they were to be properly protected to prevent the absorption of moisture. Thickness not to exceed 3/8". All materials

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Testing for comparative visibility.

*Copies of the report can be obtained from Municipal Administration Service, 261 Broadway, New York City.

Oil Treatment of Earth Roads

Investigation of more than two hundred miles of oil-treated earth roads in Missouri during more than two years of use, and conclusions therefrom

An investigation has been made of oil-treated earth roads in Missouri, and the Bureau of Public Roads publishes a report on same by F. V. Reagel, engineer of materials, Missouri State Highway Department, Henry Aaron, assistant highway engineer, U. S. Bureau of Public Roads, and W. I. Watkins, assistant soil surveyor, U. S. Bureau of Chemistry and Soils.

This report describes in great detail the conditions of 224 miles of roads oiled during May to November, 1928; inspections having been made about 2½ months after the oil was applied, again 1½ months later, in the summer of 1929, and finally in the spring of 1931. In brief, "The investigation has disclosed that oils may be used satisfactorily for the treatment of earth surfaces to provide temporary all-weather roads if certain fundamental factors are recognized. The most important factors so far discovered are: (1) Physical characteristics of the soil; (2) drainage, both surface and subsurface; (3) condition of surface immediately prior to application of oil; (4) rate of penetration of oil; (5) type of traffic; and (6) methods of maintenance."

The manner of conducting the investigation and what was learned thereby are described in great detail in the report, and the conclusions drawn therefrom finally are summarized as follows:

1. Road oil of the types included in this study is an efficient material for use in the treatment of earth surfaces to provide all-weather roads provided applications are made to suitable surfaces, adequately drained, and repeated as needed.
2. The type of oil, as regards basic crude source, is not a major factor, all types yielding fairly satisfactory results with all types of soils, other conditions being favorable.
3. Adequate drainage, both subsurface and surface, is essential to the satisfactory service of oiled earth surfaces. Adequate drainage, on flat topography, requires greater crown than ordinarily constructed on graded earth sections.
4. General profile is not a factor affecting the service of oiled earth surfaces except as it may influence the efficiency of drainage and the character of the subgrade material.
5. To reduce the effects of erosion on noncohesive types of soils, oil should be applied on the full width of roadway.
6. All types of soil included in this study can be efficiently treated with road oil.
7. The soil type is an effective factor because of the physical characteristics of the various soil layers exposed to the application of oil. The physical characteristics of the subgrade soils affect the final results according to whether the soils require only the water-proofing qualities of the oil or in addition require an increase in their cohesive properties. The condition of the surface with respect to dust, hardness of crust, and moisture content at the time of application of the oil is directly reflected in the physical characteristics of the soils. The uniformity of penetration is controlled by the uniformity, texture, and density of the several layers of a soil type.
8. Soils lacking cohesion and inclined to absorb water very readily in quantities sufficient to cause rapid loss of stability (represented in this study by A-4 subgrades), may be more effectively treated with oils having ductile and cohesive bases. Soils which possess cohesion in a high degree and which, when in a stiff or plastic state, do not absorb additional water unless manipulated (represented in this study by A-6 soils), do not require treatment with oils having cohesive bases, as waterproofing without binding will insure fairly satisfactory results. Soils which possess properties from each of the groups mentioned above but can not be placed definitely in either one may give better results if the quantity of oil applied is increased.
9. The character of the surface immediately prior to application of the oil is of major importance. Surfaces to which oil is to be applied should be fairly free from dust and should have pore spaces open to receive the oil. Final preparation of surface for treating should consist of blading to eliminate all dust, crust, and depressions of the road surface, rather than the movement of loosened material to obtain uniform cross-section. A uniformly smooth surface to insure uniform distribution of traffic over the entire roadway is essential for proper development of the surface.
10. The presence of sufficient moisture in the surface is essential in order that the pore spaces be kept open and free to receive the oil. Surfaces free from moisture tend to become dusty and hardened, causing nonuniform and selective penetration.
11. Weather conditions are a factor to the extent that they may influence the moisture content of the surface, the rate of penetration, and the quantity of oil, if loss occurs due to rainfall immediately following application.
12. Within the ranges observed in this study there did not seem to be any significant effect of air temperatures except that they might have served to speed or retard changes in the moisture content of the soil.
13. There was no apparent benefit obtained by raising the temperature of the oil for application above that required for uniform distribution. Increasing the temperature of the oil increased the tendency to flow along or from the surface by decreasing the viscosity of the oil and was detrimental rather than beneficial.
14. A retarded rate of penetration tends to improve the uniformity of distribution of the oil thereby promoting the intimate mixture of oil and soil particles which is desired. Nonuniform penetration, which usually accompanied a rapid rate of penetration, failed to produce the results desired.
15. The presence of untreated earth surfaces adjacent to oiled earth surfaces reduces to a varying extent the effectiveness of oiled surfaces particularly if the untreated surfaces are manipulated, as the untreated earth tends to deaden the treated surfaces.
16. Nonmutilative traffic is highly beneficial to oiled earth surfaces as such traffic tends to knead the oil into intimate contact with the soil particles. This intimate association is a primary requisite for successful treatment of earth with oil.
17. Mutilative traffic serioulsy impairs the service rendered. Such traffic should be prevented or minimized to the extent possible.
18. Dragging or blading of a good oiled earth surface is harmful. When reshaping is necessary a re-treatment must be given to restore the oiled surface.

Transportation Engineering Taught by University of Michigan

The University of Michigan is offering a four-year course in transportation engineering, including railway, marine, automobile, aeronautical and highway. Basing their studies upon the fundamental courses in engineering, students enrolling in this new division will be expected to give at least one-fourth of their time to subjects of distinctly cultural content.

After a year of study by a committee of the faculty, the university inaugurated a curriculum in transportation in October, 1930. Among the special facilities offered are laboratories in marine, automotive, aeronautical and highway engineering, a 300-foot marine experimental tank, wind tunnel for research in aeronautics, a general library of 800,000 volumes, and a transportation library of 70,000 items, the largest collection on this subject in the world. Information can be obtained from John S. Worley, Professor of Transportation Engineering, Ann Arbor, Mich.

Boulder City, to House the Builders of Hoover Dam

A modern city, completely designed at the start to meet the conditions of topography, climate and use.

DURING the construction of Hoover Dam, soon to begin in earnest, it will be necessary to house at least two thousand and probably five thousand people in the vicinity. There is no city there now, so the Bureau of Reclamation, Department of the Interior, is building a town, calling it Boulder City, Nevada, twenty-five miles from Las Vegas, Nevada. It is located on high land overlooking the site which will be Boulder Lake, where the air is cooler, and soil drainage and topography more favorable than at the level of the lake.

Dr. Elwood Mead, commissioner of reclamation, aims to provide on the desert here living conditions for his men which will tend to keep them in good health and contented, by making Boulder City a model city. The general plan of the city is indicated by accompanying drawing and is described by S. R. De Boer, city planner, of Denver, in "National Municipal Review" as follows:

The plan of the city consists of a large V with main traffic lines along each side and a third one through the middle. These three major streets all center in the apex of the V which is the main entrance of a government office building. Two other buildings for government use form, with the first one, a small civic center group with an open park on the side of the city. In this way the government buildings are the focus point of the city, which will lie fan-like to the south of the building group.

Many new thoughts are embodied in the plan of Boulder City. An attempt has been made to design a city which, from the standpoint of the business district, as well as from that of the residential areas, prevents the transportation difficulties common to modern cities. Among the new ideas embodied in the plan are:

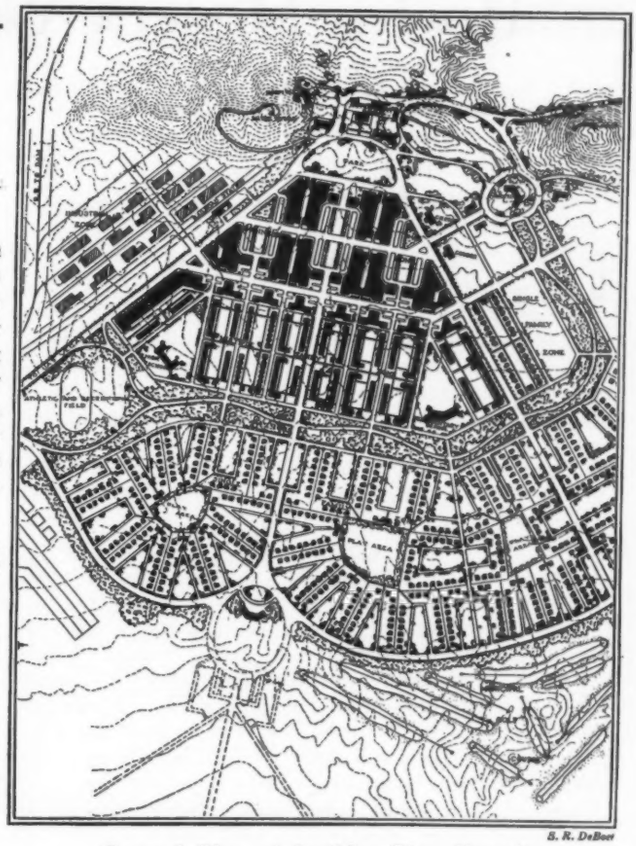
1. In the business district the parking of automobiles on the streets will be prohibited. Instead of the usual curb parking, provision is made for the parking of automobiles on open plazas.

2. Instead of business streets, all stores and offices are located around open squares, the interiors of which are to be used for parking automobiles.

3. With this arrangement it is possible to create store groups of unusual beauty. With automobile parking space in the plazas in front of the stores, customers can drive within close proximity to the business houses.

4. The grouping of stores around the squares will be done according to the laws of natural zoning found in nearly all cities, namely, stores for clothing and wearing apparel will be together and so will grocery and foodstores, furniture and hardware stores, printing shops, laundries, automobile service stores, etc. Among these will be placed stores of general service such as restaurants.

5. Instead of the usual corrective measures embodied in zoning laws, an attempt will be made to regulate all building matters by architectural control. A master plan has been made to which all buildings must fit. With the use of the plaza plan this is expected to give unusual results.



General Plan of Boulder City, Nevada

6. On the plan, through traffic and business have been separated.

7. The provision of many zoning ordinances for extra open space along alleys to afford loading and unloading space for trucks has been embodied in the street plan, in other words the extra width is dedicated to the public.

8. The multiple family zone adjoins the business district and consists of long blocks in which the middle part has been kept open to be used as a block playground. These blocks are 900 feet long and cut in the middle only by a walkway. In this way cross streets are avoided. The houses are to front in and garage will be on the street side.

9. A wide belt of forest is placed around this first unit of the city. Forest planting is used on account of its greater economy of maintenance in the hot desert location as compared with regular park treatment.

10. A new type of open residential development is proposed outside of this forest belt. It consists briefly of the elimination of all streets from a fifty to sixty acre area of homes with the exception of the boundary streets. The boundary streets are the main arteries of the city. On these boundary streets are placed a number of groups of homes placed around the outside of a V-shaped open tract. Every group contains eighteen homes. The space inside the V

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How a Modern Water Supply Saved Lake Odessa

By E. G. Garlinger
Former Village President of Lake Odessa, Mich.

UP to 1928 the natural water supply from several nearby small wells had supplied the village of Lake Odessa, Mich., with water. But the growth in population, the natural spread of our business section limits and of our outlying residential sections, had gradually rendered this limited well-water supply inadequate for the proper protection of our properties in case of fires, droughts or other emergencies. It was true there was enough water for purely domestic purposes, and since no serious emergencies of alarming proportions had thus far threatened our village, our people were content to live peacefully on, day by day, ignoring any possible dangers.

Fortunately for the town, we had a capable and far-sighted man in charge of our water supply, Bruce Ritter, our present water works superintendent, and after talking the situation over with Mr. Ritter we fully realized the seriousness of our lack of adequate water reserve for combatting fires, droughts, etc., and we foresaw the impending consequences of too long a delay in remedying our town's deficiency in water.

Unfortunately, similarly serious water supply deficiencies exist today in thousands of average sized communities all over the United States.

Despite the active opposition of the majority of our leading citizens and voters, but backed by our own knowledge of the real situation, in 1928 I executed the town's order to the Pittsburgh-Des Moines Steel Company for an elevated water tank to provide us with an emergency reserve of water at all times. This tank was erected in quick time. It stands on a steel tower over 90 feet high, and provides a reserve supply of 75,000 gallons.

At the election in the fall of 1928 I was defeated for re-election as village president, largely because I was held responsible for placing the contract for this additional water supply equipment.

On the afternoon of July 16, 1930, Lake Odessa experienced a terrific explosion and the most disastrous fire in its history. The center of our business section was wrecked, and our entire town appeared doomed. My produce store, near the center of the town, was damaged and my garage was destroyed. Help from all the neighboring towns was called for and seven fire companies responded. With their equipment and additional water lines added to our own two fire trucks, and, most important of all, with the 75,000 gallons of water on hand in our new tank, the combined fire fighters put out the fire, but not before three men had been killed.

The new water tank enabled us to extinguish this stubborn blaze, and in doing so it *actually saved our town.* Our residents and citizens were saved thousands of dollars worth of real estate and personal property, or many times the moderate cost of its erection two years before. Naturally, I cannot help but

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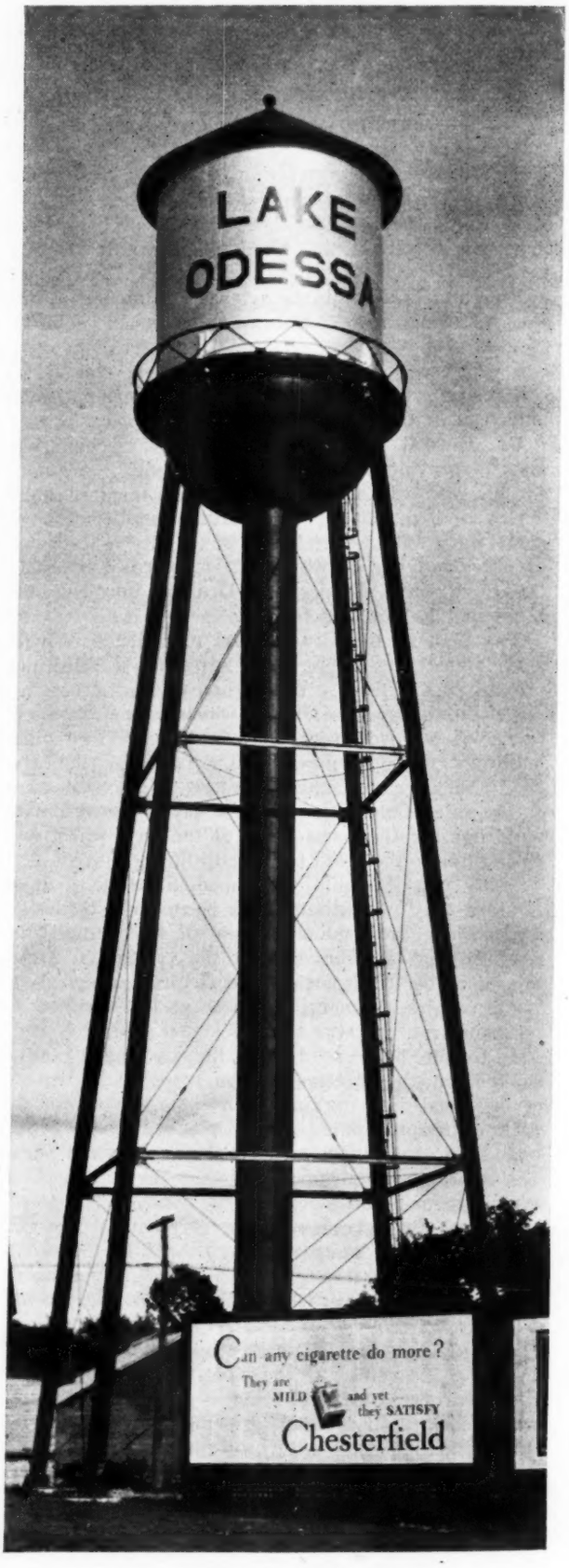


The tank which saved Lake Odessa.

Liberty Solves Its Sewage Treatment Problem

Builds a modern plant for a summer population of over eleven thousand for about thirty thousand dollars—mechanical sludge collectors, digestion tanks, glass-covered sludge beds and chlorination.

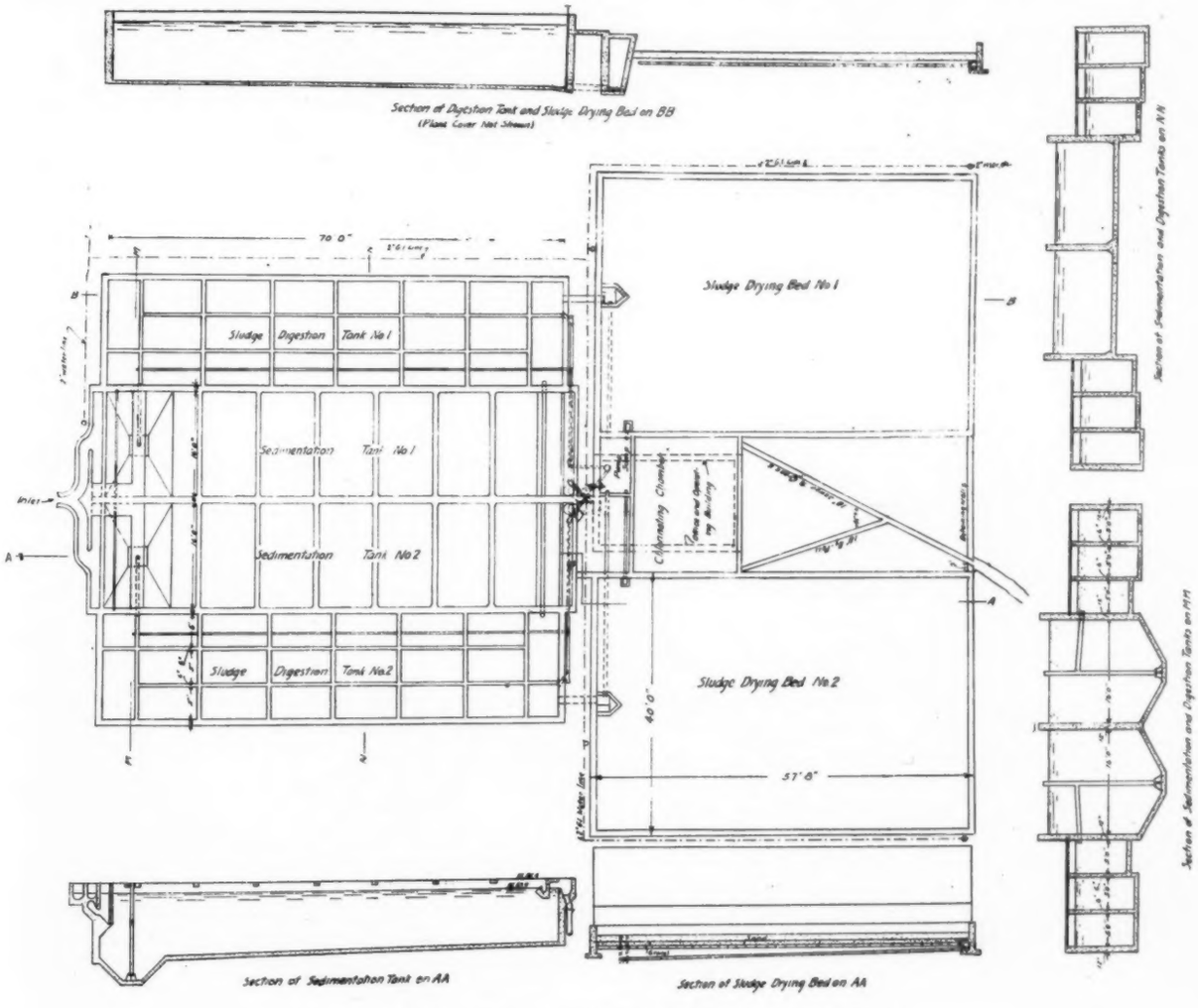
WITH an expenditure of slightly over $30,000, the Village of Liberty, N. Y., has solved the problem of disposing of its sewage—a problem that has been a source of worry to its officials and citizens for many years. A modern type of treatment plant is now being built to replace an antiquated and overloaded plant built nearly forty years ago. That plant served well, but it was designed to treat only about 150,000 gallons per day, whereas the present summer volume of flow is around a million gallons per day. The new plant is designed to handle the estimated flow for some twenty years to come.

The Movement for the New Plant

In 1920, troubles in connection with the old plant became acute. In 1923, about $5,000 was expended in betterments, and a full-time operator was employed. In 1925, an engineer was employed to prepare plans for a new plant, but the bonds for its construction were defeated. In 1930, under the leadership of E. Leslie Cooper, chairman of the Board of Sewer Commissioners, the matter was again brought up. At this time it was planned to design a plant that could be constructed unit by unit, from current funds and sewer rental income, and the plans for the new plant, providing for this feature, were approved by the State Board of Health. However, the interest aroused among the taxpayers was so favorable, that, under the New York state law, the Village Board voted bonds for the entire cost of construction and, no protest being filed, a bond election was not required.

Financial Aspects of the Plant

The estimated costs for the new plant totalled $34,500; extensions to present sewers not connected with the plant were estimated to cost $5,000, and bonds for $40,000 were voted. The estimated saving in operation of the new plant as compared to the old one, totalling about $3,000 per year, will go a long way toward paying for the new plant. The plant is now under construction by contract, and it is estimated that the total cost will be in the neighborhood of


Section of Digestion Tank and Sludge Drying Bed on BB
(Plant Cover Not Shown)
Section of Sedimentation and Digestion Tanks on NN
70'0"
Sludge Digestion Tank No 1
Sedimentation Tank No 1
Sedimentation Tank No 2
Sludge Digestion Tank No 2
Chlorinating Chamber
Sludge Drying Bed No 1
Sludge Drying Bed No 2
40'0"
57'6"
Inlet
Section of Sedimentation Tank on AA
Section of Sludge Drying Bed on AA
Section of Sedimentation and Digestion Tanks on MM

General plan, with cross-sections, of Liberty sewage plant.

$32,500. The remainder of the bond issue will be used for sewer extensions, largely to hotels outside of the village limits, which will result in a considerably increased sewer rental income to the Village. Therefore, the new plant will, to all practical purposes, pay for itself within the period for which the bonds were issued.

Bases of Design

The 1930 census showed the population of Liberty in 1930 to be 3,495. A population for 1940 of 4,400 and for 1950 of 5,500 was used as a basis of design. In addition to this permanent population, there is a summer population of 7,000, for Liberty is a popular summer resort. Though experience has shown that the water consumption of the permanent residents averaged 100 gallons per day, and of the summer residents only 35 gallons per day, per person, the plant design was based on per capita use of 100 gallons per day, or a total flow in 1940 of 1,140,000 gallons per day.

At the time the plant was designed, the regulations of the New York State Board of Health required a 3-hour detention period for plants of this type, and the provision of 3 cubic feet per capita for sludge digestion tanks. Between the time that bids were called for and opened, the requirements were reduced by 33 1/3%, so that the plant should handle a load 50% in excess of the estimated flow in 1940. All sewers and channels are designed to carry 250% of the estimated flow of 1940.

Description of the Plant

The plans call for two settling tanks equipped with mechanical sludge collectors, two sludge digestion tanks, two glass-enclosed sludge drying beds, and chlorination of all effluent before discharge into the creek. Space is reserved for later construction of filters or other means of oxidation treatment of the effluent, should each treatment be decided to be necessary.

Sedimentation Tanks.—There are two of these, each 16 feet wide, 70 feet long, and 8.5 feet average depth. The bottom slope toward the hopper is 2%; an allowance of 6 inches for height of collector vanes, and a freeboard of 1.5 feet, gives a total depth of 9.8 feet at the outlet and 11.2 feet at the inlet. A sludge sump or hopper is provided at the inlet end of each tank, from which the sludge is removed by hydrostatic pressure when a valve is opened. Link-Belt sludge collectors are being installed in these tanks, and sludge will be removed daily.

On a basis of flow of 1,140,000 gallons daily in 1940, which it is estimated, will be the maximum summer flow, these tanks will provide a detention period of 3 hours.

Digestion Tanks.—There are two digestion tanks, each 16 feet wide and 70 feet long. With the two settling tanks, these form a unit of four tanks of identical length and width. The digestion tanks are placed on either side of the pair of settling tanks, as shown in the plant layout drawing. Each tank is divided into three channels by partition walls, so as to give a total length of flow of sludge of 200 feet. The bottom slope is 1%. The depth at the inlet is 7.8 feet and at the outlet 9.8 feet, not including a freeboard of 1.5 feet.

The capacity of these tanks was based on the weighted average of the load on them. With a winter population of 4,400, and a summer population of 11,400, it was deemed safe to provide for the mean annual population, which was estimated at 6,150, on the basis of 3 cubic feet per capita. On the basis of 2 cubic feet per capita, the population which can be served will be 9,225. With digestion of sludge normally most active in the summer, at which time the load on the plant will be greatest, these assumptions are believed to be safe.

Sludge Drying Beds.—The sludge drying beds also were designed on the basis of a mean annual population of 6,150. There are two beds, each approximately 40 feet wide by 60 feet long, giving a total area of about 4,800 square feet. These are of the usual design, but drainage from them is collected by a system of tiles and discharged into a pump pit, whence it can be pumped into the digestion tanks, into the chlorination tank, or onto sand filters.

Chlorination Tank.—A chlorination tank is provided which will give a retention period of 15 minutes. This is located between the sludge beds, and its roof forms the floor of the office building. No openings connect the interior of the tank with the office, the chlorinator room or the pump room.

Other Details.—A by-pass is provided around the chlorination tank only. A weir will be installed at the overflow of this tank, and connected to a recording device that will give a complete record of the flow through the plant. It is likely, also, that a small pump or injector will be attached at the chlorinator to allow for prechlorination which, it is believed, may show some advantages in this plant.

The Mongaup brook, into which the plant effluent will be discharged, has a watershed area of 11.3 miles above the plant.

In designing the piping of the plant, no specials were employed except for the supports of the sludge discharge risers, which are being cast locally. In general, a real effort was made to secure the greatest simplicity in the design, so that local contractors would not be handicapped in bidding on the work.

Letting the Contract

Bids were called for May 22, 1931. There were five bidders, two of them being local firms. The contract was awarded to E. W. Martin of Liberty, who was low bidder at $29,993.50. Work began on June 10, and despite interruptions due to unfavorable weather conditions, the plant is now about half completed, and is expected to be put into service some time during the latter part of September. A small amount of extra work is contemplated, most of it connected with improvement of the grounds, and landscaping. The old plant, which is located some 500 feet north of the new plant, will be demolished as soon as the new plant is put into operation.

Considerable attention is being directed to the appearance of the plant and the surrounding grounds. Excavated material has been used to fill in low places, and to provide a driveway and parking area. The course of a small creek has been changed. Top soil, which was removed before excavation began, will be used to cover the fill, which will be seeded and planted, as far as is possible.

(Continued on page 55)

Water Distribution by the Two-Main System

By J. Edward Schipper

Result of making service connection to a one-main system.

PRACTICALLY every town and hamlet in the United States today is concerned with its streets and roads, and therefore with its utilities, such as water and gas. The installation of one very materially affects the other. If the mains for water and gas can be laid before the street is paved it is a great advantage; but, whether or not this is done, modern practice demands that there shall be a minimum of road surface destruction for the purpose of installing and maintaining service lines for water and gas to buildings on either side of the street.

The trend toward the use of the "two-main system" for water and gas lines in the larger cities is extending to include the smaller towns and villages. By installing two mains, one on each side of the street between the curb and the sidewalk, there need never be any reason for cutting into the paved surface of an expensive road for the installation or upkeep of service lines.

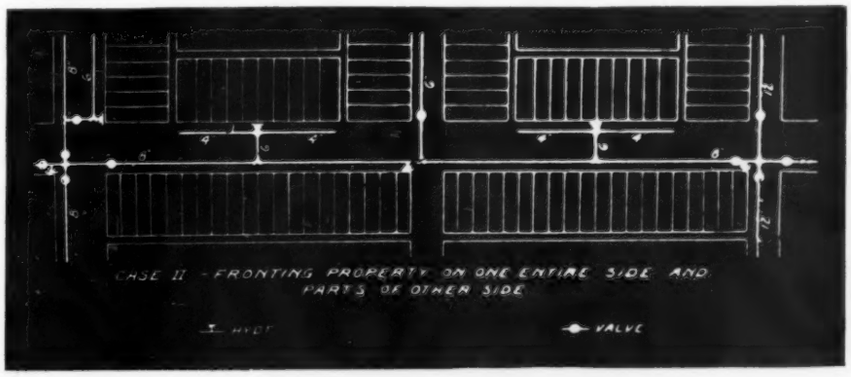
With a single-main system it is necessary to cut through the surface of the roadway every time a service line is to be installed or repaired. After refilling, shrinkage occurs in the majority of cases, with the resultant break-down of the road surface. This not only mars the appearance of the highways but causes great inconvenience and often damage to motor vehicles using the road. Occupants of neighboring houses, offices and stores are annoyed by the constant pounding of heavy vehicles dropping into the depressions caused by shrinkage of the back-fill. Needless to say, this continuous pounding causes still further road destruction. Sometimes it requires two or three expensive operations to bring back the road surface to its normal level condition.

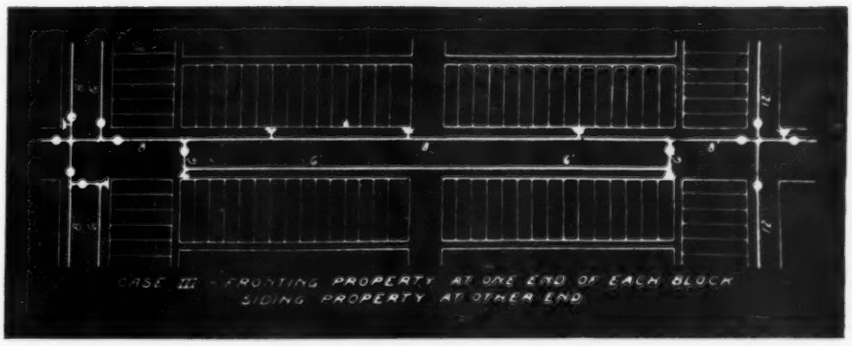
Because of the fact that roadways in small towns and villages are much wider than those normally used in the larger cities, the first cost of installation of a two-main system in the former is often lower than it would be for a single-main system; maintenance and service installation costs are certainly lower.

It is not necessary with the two-main system to dig up the road surface to make service installations. There is no need for trenching beneath proposed pavements. Neither is there any need for the delaying of laying of pavement for the settlement of ditches which have had to be dug for service installations. Other advantages include additional main capacity, and the better fire protection provided with the two mains. In case of construction work there is no need for interfering with street traffic in any way.

While the bus has taken the place of the trolley car through most of our village streets there are still a large number of interurban trolley services throughout the country. With the two-main system the danger of damage by electrolysis is very much reduced.

Generally speaking, with roads 55 feet or more in width, even the first cost may be said to favor the two-main system. When the cost of maintenance, service installations, upkeep of dead service lines and the losses resulting from traffic delays and inconveniences are added together, the slight differences in favor of the single main system due to lower first cost on narrow roads disappear.





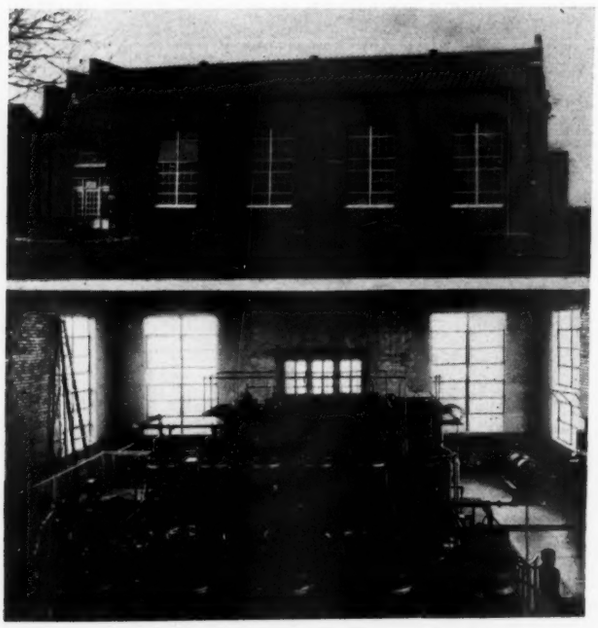
Variations in application of the two-main system.

It does not take a municipal engineer to appreciate the value of elimination of trenching beneath the pavement for the installation of service lines. Even when the service lines are installed before the pavement is laid, and there is no need for excavating the pavement itself, it will be found that settlement is bound to take place for a considerable time afterwards, thus resulting in damage to the pavement. With the two-main system there is never any delay necessary in laying pavements, as neither the pipe trenches nor service pipe trenches will be in a part of the street where the pavement is to be laid. In new sub-divisions particularly, the desire to make property saleable makes this feature important, as there is no need for delaying paving because of water works construction. Neither is there any need for re-laying the pavement due to failure because of settlement.

Street openings are always bad, whether in a small or large town. They bring traffic congestion and are often the cause of accidents. If the excavation can be confined to the park space, which is that space between the curb and the sidewalk, it can be done without inconvenience to either pedestrians or road users. There is no inconvenience to those who use the sidewalks or those who use the roads.

These are points that the city or village fathers can well take into consideration when planning new districts or issuing contracts for work to serve new sub-divisions. Completely installed two-main systems add to the value of adjacent property and represent positive insurance against unsightliness, inconvenience, noise and even danger in the years to come. Pipe installations are made for permanency and so is modern road construction. The two-main system will go far toward permanently maintaining the integrity of road surfaces and water and gas services.

Among other sources, the author has drawn material for this article from a publication issued by the Cast Iron Pipe Research Association, to which organization acknowledgement is hereby gratefully rendered.



Exterior of building of light plant. Below—Interior, showing mechanical equipment. Fairbanks-Morse engines in the rear.

Cost of Pipe Installation

The following estimate has been made of the cost of a two-main vs. a single main system. The street is assumed to be 66 feet wide from lot line to lot line; lots 30 feet wide; services installed for each lot extending from the main to the property line. The cost of 1,000 feet of street would then be as follows:

Single Main System

1000′ 6″ Cast Iron Pipe installed @ 1.75 per ft.	$1,750.00
66 services from main to lot line, complete with corporation cock, round way and shut off box 2178′ @ $1.30 per ft.	2,831.40
Valves	80.00
	$4,661.40

Two-Main System

2000′ 6″ Cast Iron Pipe installed @ $1.75 per ft.	$3,500.00
66 services 2′ long complete with corporation cock, round way and shut off box	594.00
Valves	160.00
	$4,254.00

Under the above conditions, the saving in first cost is $407.40 per thousand feet of street. Had the width of street been 55′ instead of 66′, the first cost of the two systems would have been identical. On the other hand, had the width of street been 100′ instead of 66′ and the width of the lots 50′ instead of 30′, the saving in first cost would have been $140 per thousand feet of street. While these estimates are based on actual bid prices, it should be borne in mind that in any particular case the engineer should make an estimate in order to see which system is more economical.

Oil Power Plant Cheaper Than Steam to Operate

By Bennett B. Smith

Cameron, Missouri, like many small cities and towns, built its light plant in the heart of the business section a number of years ago, where it was one of the show places of the city. The city had purchased a small, privately owned steam plant which had been in use a few years, and moved it to this new building.

By 1924 the demands for current had so increased that the old plant was being overloaded continually, and agitation for a larger one had reached the point where the Board of Public Works, after inspecting plants in several other towns, ordered new machinery —three Fairbanks-Morse engines, Type Y, two of 300 h.p., 200 kw., and one of 200 h.p., 135 kw. This began operating in October, 1924. As it had previously been shown by test to be in perfect running order, there was no break in service—the old plant stopped and the new one started at the same instant.

It was thought that this plant had ample capacity for many years, but in 1929 it was necessary to increase it, and the 135 kw. unit was replaced with a new 700 h.p., 465 kw. unit at a cost of $43,000.

After operation for seven years the new plant has demonstrated its superiority over the old steam plant. With the latter there were frequent stops and numerous troubles; while the time the new plant has been stopped during the seven years has totaled only one

(Continued on page 55)

THE EDITOR'S PAGE

For Officials of Small Municipalities

To the thousands of officials of the smaller communities throughout the United States PUBLIC WORKS dedicates the greater part of this issue. For the most part without special training or experience in such work, these men are solving successfully the many problems connected with the administration of municipal affairs to the end that conditions of life in their communities may be made better. Underpaid, or in many cases not paid at all, they are devoting their time and energy to public service.

PUBLIC WORKS desires to help in this service and offers them advice and assistance in any public works project. Do not hesitate to write us if you want information on any subject connected with problems in this field.

Unemployment Relief and Public Improvements

In every community are stirrings to provide for relief for the unemployed. Odd things are happening. A department head in a large city announces that he will discharge a hundred chauffeurs, saving the hundred dollars a month each is paid so that it may be devoted to unemployment relief. Maybe it doesn't enter his head that he is contributing also to unemployment.

Local responsibility is the common-sense way of meeting the relief situation. And the equally common-sense way of meeting the local situation is, in the great majority of cases, to carry on some of the much-needed public works construction. Not cutting brush in parks; not cleaning up vacant lots; but honest-to-goodness improvement work. A new sewage treatment plant; extension of sewer lines and water mains; improvement of streets; construction of sidewalks; painting and maintenance of public buildings. In what community are these things not honestly needed? What community can not afford to do them? When weighed against the cost of other methods of relief, it will be found that these *permanent, needed, substantial* and *constructive* improvements can be made at a less cost than ever before, and probably less than ever again. The money will undoubtedly be raised and spent. Why not spend it for worth-while things?

Buy the Best—From Responsible Firms

In our May issue, we commented on some of the practices adopted by manufacturers of engines, which were designed to sell on a price basis only. In our June issue, we cited the case of a western municipality that bought some water filters on the same basis. Another instance along the same general line has since been brought to our attention. In a number of cases, local machine shops and blacksmiths have purchased various types of construction equipment manufactured by well-known and responsible firms, and then have reproduced this equipment, copying the design down almost to the last rivet. The product for obvious reasons is usually sold at a reduced price. Unfortunately, many local officials seem to feel that they should patronize such concerns.

Irrespective of the ethics involved in the case, this is no time—if there ever is a time—to buy cheap or makeshift equipment. It is mortgaging the future for a small present saving. When a snow plow, for instance, is needed, it *is* needed. It isn't worth a cent in the shop. And how about this "orphan" equipment in a year or two? Will the official who bought it point to it with pride and say "I bought that?" Maybe so! Maybe so! But we doubt it.

Its Streets Should Be the Glory of the Small City

Each size and type of city should select the kinds of street improvements suitable for its own conditions, and not copy those used in cities which are larger or whose traffic conditions are entirely different.

Also it should vary the type of street improvement with the nature of the street. In a small city or town heavy-traffic pavements are out of place on any except the one or two main streets; elsewhere they are an unwarranted expense to the property owners, and detract from what is really an asset to a small community—the suburban, home-like appearance of a tree-shaded, wide-lawned street of comfortable residences. A road improvement that is qualified for heavier traffic than it carries is a double liability, once in the construction cost, and even more in its effect on the value of residence property and of the town itself as a residence community.

The small city or town has something to offer that the large city can not have—tree-shaded streets, quiet and restful, in contrast with the noisy, glaring streets of the city. Why try to compete with the city in something in which success is not only impossible but undesirable? Instead, wise planning calls for dustless low-cost roadways, harmonious in appearance with the shaded walks which are separated from them by grassed parking strips and from the residences behind a prescribed set-back line by a generous width of lawns and gardens.

Such streets need to be "planned" just as much as the traffic streets of a large city. There are thousands of communities of under ten thousand population in the United States, but only a few dozen stand out as examples of the kind of place millions of us would like to live in. These did not just happen—they were wisely planned under the direction of public spirited men, backed by communities which believed in themselves and realized their possibilities as small cities or towns, not trying to be, or appear to be, something else.

Does your community wish to be one of these few, or is it content to be just another small town? It does not require much money to become one of the few, but it does require a community desire to attain this end and, like every other worth-while attainment, wise planning and consistent adherence to the general features of the plan through many patient years.

Bacteria and the Water Supply

Information furnished by bacteriological examinations and use in determining safety of a water supply. How test samples should be taken.

GENERALLY speaking, a bacteriological examination of water provides circumstantial evidence from which the engineer or bacteriologist is able to infer whether or not the water examined may be used with safety as a drinking water. Conditions at the time the sample was taken only are shown. There is no evidence as to what future conditions may be, though tests made at frequent intervals over a long period of time may give an indication of what reasonably may be expected.

A bacteriological examination does not give the whole story. It should be supplemented by a sanitary inspection of the source and in some cases, by a chemical examination. Even though a bacteriological examination shows the water from a well to be free from objectionable bacteria, if it is found that the cover of that well is leaky, the casing is imperfect, and the well subject to surface wash, that water is not safe to use, because it is only a question of time before serious contamination will occur.

But where favorable conditions have been established, as at a municipal water purification plant, then routine and regular bacteriological examinations are of great value in checking operation and in disclosing possibly dangerous conditions at an early moment.

The Information Wanted

The information that is sought in making a bacterial examination of water includes (a) the kind of bacteria present, and (b) the number present. Search is not generally made to determine the exact species of an individual bacterium, but rather to find the type. If search were made for B *typhosus*, the organism that causes typhoid fever, the work would be involved and difficult, and this bacterium would rarely be found. Instead, the water is tested for B *Coli*. This organism is much more numerous and more easily found. It is a normal inhabitant of the intestinal tract, and its presence indicates sewage contamination. Though harmless in itself, it is a danger signal, for when sewage enters the water supply there is always grave danger that it may contain typhoid bacilli. Therefore the presence of B *Coli* is ample reason for regarding the water as unfit and dangerous to use.

The type or kind of bacteria is therefore important, as showing the nature of the contamination. The number of bacteria also is important as showing the extent of contamination. Thus a large bacterial count—several hundred or thousand per unit of water tested—indicates heavier contamination, and consequently more danger, than would a tenth of that number.

Types and Numbers of Bacteria

There are, of course, a vast number of kinds of bacteria, but the engineer or water works man is interested in only a few of them. One classification is based on shape and the names given are descriptive. Thus, *bacilli* are rod shaped; *cocci* are round; and *spirilla* are spiral. Those bacteria of importance in water purification are mainly, if not entirely, of the *bacilli* group. The most important are *bacillus typhosus* and *bacillus coli* and other causative agents of intestinal diseases and inhabitants of the human intestines.

The number of bacteria in water varies greatly according to the source of supply and the amount of contamination. Well and spring waters commonly show less bacteria than lake, river or other surface waters; and water drawn from lakes and rivers into which sewage is discharged contains more bacteria than water obtained from a source that is free from contamination.

While the number of bacteria present is of less importance than their character, yet the number is significant, because, where it greatly exceeds those commonly found in water from such a source, it is reasonable to assume that a certain proportion of them are dangerous. It is the usual practice, therefore, in making a test of this sort, to count the total number of bacteria in a small amount of water (usually 1 cubic centimeter) and then to test for those bacteria that indicates dangerous contamination.

Collection and Examination of Water Samples

The tests for bacterial contamination are very delicate, and therefore it is necessary to use great care in taking a sample of water, so that outside contamination will not be added, thus making the water appear worse than it really is. Samples should be taken only in bottles received from the laboratory. It is generally a waste of time to take and send samples in any other bottles. Only a small quantity is needed, usually 2 to 4 ounces.

If the sample is to be taken from a faucet, the water should be allowed to flow until that in the service pipe has been wasted; if from a pump, all the water in the pump connections should be drawn off first; if from a stream or lake, the bottle should be plunged under the surface before removing the stopper. After taking the sample, the stopper should be replaced without touching that part of it that may come in contact with the water in the bottle, and should at once be covered with a cloth or paper hood. The bottle should reach the laboratory within a few hours after receiving the sample, but if this is impossible, the bottle may be packed in ice for shipment.

The details of water examinations are very interesting, but the processes are too long to describe here. Briefly, a small amount of the water is mixed with *agar*, a special gelatine-like substance, and allowed to remain for 24 hours in an incubator. During this period the bacteria multiply so rapidly that each individual bacterium, invisible to the naked eye, develops into a family or "colony" which can be seen easily. The number of colonies present can be counted and each is assumed to represent one bacterium in the sample. Further tests are then made to secure additional information regarding the kind of bacteria.

Thus, results of bacterial examination require 24 hours or more, possibly several days, depending upon just what information is desired.

Control of Water Supplies

The frequency with which a community water should be tested depends almost wholly on local conditions. Many cities take samples and make bacterial tests every day, and this is a desirable practice where

(Continued on page 76)

How Wide On Curves?

By D. Y. Bate

Junior Civil Engineer
Dept. of Public Works,
City of Los Angeles, Cal.

RECENTLY, while working on the design of a curvilinear, sidehill street on which extremely sharp curves were encountered, the question arose as to the proper additional width on these curves, as well as superelevation.

In the June issue of PUBLIC WORKS, the results of investigation of superelevation were given under the caption. "How Much Superelevation on Curves." Pending further investigation of the proper additional width, an arbitrary amount was used. Since then several of the State highway departments have been communicated with and in most cases extreme courtesy was shown in giving their complete data and information.

Bulletin No. 17, "Instructions to Inspectors in the Field," was received from Department of Highways,

COMMONWEALTH OF PENNSYLVANIA, DEPARTMENT OF HIGHWAYS

STANDARD METHOD OF SUPERELEVATING AND WIDENING CURVES

Superelevation

Curves of one degree or more will be superelevated in accordance with the accompanying tabulation. This table is based on a variable rate of superelevation ranging from 1/8" per foot of width for a one degree curve to a maximum of 1" per foot for curve of 9° and over on grades from 0 to 6%.

Compensation is made for grades over 6% on curves of 6° and over, and the rate of superelevation increases to 3/4 of an inch per foot of width for a 6° curve up to a maximum of 1 1/4" per foot of width for curves of 9° and over.

On flexible types of pavement and on *grading* and *drainage projects*, all curves will be superelevated in accordance with the table, and the crown removed.

On rigid types of pavement, all curves will be superelevated according to the table but the crown will be removed only when extra width is required.

Full superelevation will be attained at the P. C. and P. T. with runouts as shown in the table.

The normal grade of the inside edge of the pavement will be held as a base line from which all superelevation will be applied to the outer edge of the curve. This applies to widened curves as well as to curves of standard width.

Thickness of One Slope Roadway

The thickness of the superelevated section at the center and edges shall be the same as the standard section on which superelevation and widening is not required.

Widening

Curves of 9°-30' to 12°-45' inclusive.—Sixteen and eighteen-foot pavements will be widened two feet.

Curves of 13°-00' to 25°-30' inclusive. Sixteen and eighteen-foot pavements will be widened four feet, and twenty-foot pavements will be widened two feet.

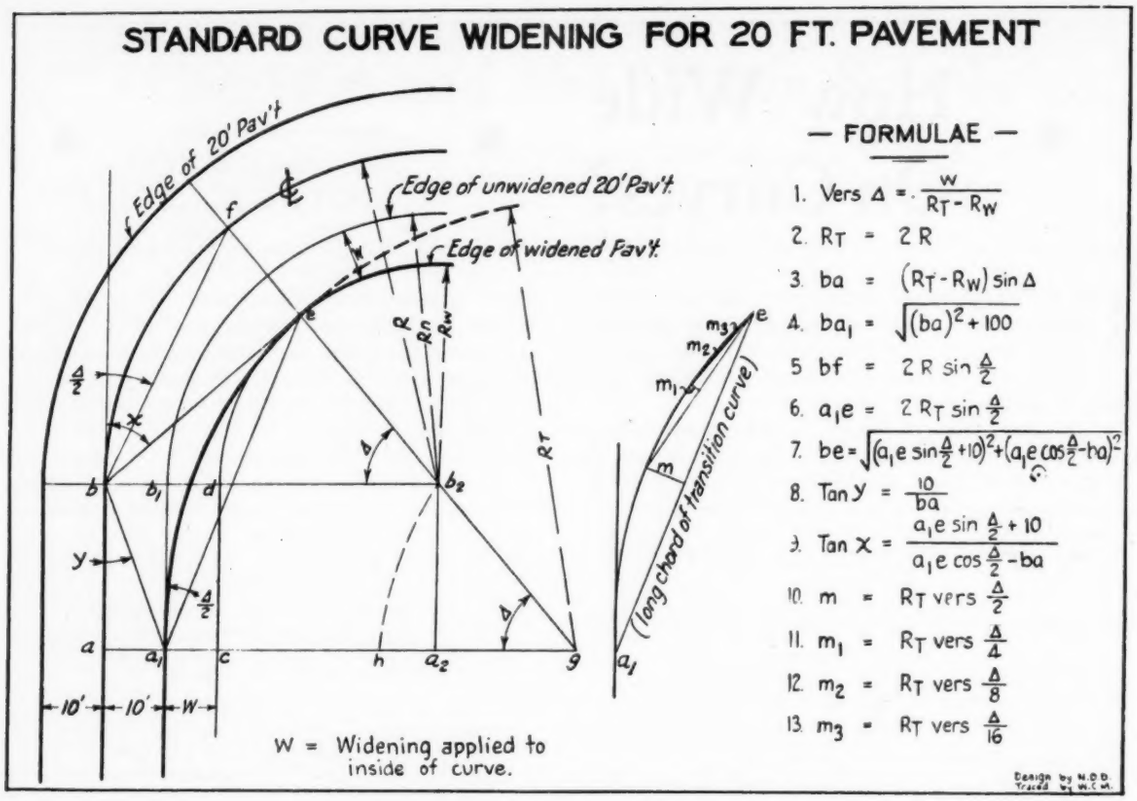
Curves of 26°-00' and over. Sixteen and eighteen-foot pavement will be widened six feet and twenty-foot pavements will be widened four feet.

The widening will begin at a point fifty feet in advance of the P. C. and full extra width will be attained at a point fifty feet beyond the P. C. For convenience in staking out, approximately 1/4 of the total extra width will be attained twenty-five feet in advance of the P. C.; 1/2 at the P. C.; and approximately 3/4 of the total extra width twenty five feet beyond the P. C. The same procedure is to be followed at the P. T.

These easements must be staked to provide a smooth connection between the tangent and the full width curve.

Degree of Curve	Rate of Superelevation Per Foot of Surface Width		16' PAVEMENT			18' PAVEMENT			20' PAVEMENT			Superelevation "Runout," in Advance of P.C.
	GRADES		Total Width	Total Superelevation GRADES		Total Width	Total Superelevation GRADES		Total Width	Total Superelevation GRADES		
	0 to 6% Inc.	Over 6%		0 to 6% Inc.	Over 6%		0 to 6% Inc.	Over 6%		0 to 6% Inc.	Over 6%	
1°00'	1/8"	1/8"	16'	2"	2 "	18'	2 1/4"	2 1/4"	20'	2 1/2"	2 1/2"	50'
1°30'	1/8"	1/8"	16'	2"	2 "	18'	2 1/4"	2 1/4"	20'	2 1/2"	2 1/2"	50'
2°00'	1/4"	1/4"	16'	4"	4 "	18'	4 1/2"	4 1/2"	20'	5 "	5 "	60'
2°30'	1/4"	1/4"	16'	4"	4 "	18'	4 1/2"	4 1/2"	20'	5 "	5 "	60'
3°00'	3/8"	3/8"	16'	6"	6 "	18'	6 3/4"	6 3/4"	20'	7 1/2"	7 1/2"	70'
3°30'	3/8"	3/8"	16'	6"	6 "	18'	6 3/4"	6 3/4"	20'	7 1/2"	7 1/2"	70'
4°00'	1/2"	1/2"	16'	8"	8 "	18'	9 "	9 "	20'	10 "	10 "	80'
4°30'	1/2"	1/2"	16'	8"	8 "	18'	9 "	9 "	20'	10 "	10 "	80'
5°00'	5/8"	5/8"	16'	10"	10 "	18'	11 1/4"	11 1/4"	20'	12 1/2"	12 1/2"	90'
5°30'	5/8"	5/8"	16'	10"	10 "	18'	11 1/4"	11 1/4"	20'	12 1/2"	12 1/2"	90'
6°00'	5/8"	3/4"	16'	10"	12 "	18'	11 1/4"	13 1/2"	20'	12 1/2"	15 "	90'
6°30'	3/4"	7/8"	16'	12"	14 "	18'	13 1/2"	15 3/4"	20'	15 "	17 1/2"	100'
7°00'	3/4"	1"	16'	12"	16 "	18'	13 1/2"	18 "	20'	15 "	20 "	100'
7°30'	3/4"	1"	16'	12"	16 "	18'	13 1/2"	18 "	20'	15 "	20 "	100'
8°00'	7/8"	1 1/8"	16'	14"	18 "	18'	15 3/4"	20 1/4"	20'	17 1/2"	22 1/2"	110'
8°30'	7/8"	1 1/8"	16'	14"	18 "	18'	15 3/4"	20 1/4"	20'	17 1/2"	22 1/2"	110'
9°00'	1"	1 1/4"	16'	16"	20 "	18'	18 "	22 1/2"	20'	20 "	25 "	120'
9°30'	1"	1 1/4"	18'	18"	22 1/2"	20'	20 "	25 "	20'	20 "	25 "	130'
10°00'	1"	1 1/4"	18'	18"	22 1/2"	20'	20 "	25 "	20'	20 "	25 "	130'
12°45'	1"	1 1/4"	18'	18"	22 1/2"	20'	20 "	25 "	20'	20 "	25 "	130'
13°00'	1"	1 1/4"	20'	20"	25 "	22'	22 "	27 1/2"	22'	22 "	27 1/2"	140'
25°30'	1"	1 1/4"	20'	20"	25 "	22'	22 "	27 1/2"	22'	22 "	27 1/2"	140'
26°00'	1"	1 1/4"	22'	22"	27 1/2"	24'	24 "	30 "	24'	24 "	30 "	140'

NOTE: For curves above 26° the *maximum superelevation* on grades of 0 to 6% inclusive, is 1" per foot of surface width and for grades over 6% the *maximum superelevation* is 1 1/4" per foot of surface width. The maximum extra width for 16' and 18' pavements is 6' and for a 20' pavement is 4'.


STANDARD CURVE WIDENING FOR 20 FT. PAVEMENT
Edge of 20' Pav't
Edge of unwidened 20' Pav't
Edge of widened Pav't
— FORMULAE —
1. Vers Δ = W / (RT - RW)
2. RT = 2 R
3. ba = (RT - RW) sin Δ
4. ba1 = √((ba)² + 100)
5 bf = 2 R sin Δ/2
6. a1e = 2 RT sin Δ/2
7. be = √((a1e sin Δ/2 + 10)² + (a1e cos Δ/2 - ba)²)
8. Tan y = 10/ba
9. Tan X = (a1e sin Δ/2 + 10) / (a1e cos Δ/2 - ba)
10. m = RT vers Δ/2
11. m1 = RT vers Δ/4
12. m2 = RT vers Δ/8
13. m3 = RT vers Δ/16
(long chord of transition curve)
10' 10' W
W = Widening applied to inside of curve.

Curve widening diagram, California Division of Highways.

State of Pennsylvania. After a study of their data and comparison with calculated results, A. E. Keeley, assistant to the chief engineer, was asked upon what their tables were based; i. e., calculations, observations of necessary additional width, or tests of vehicles under known conditions? His reply:

Since sending you a copy of our "Instructions to Inspectors in the Field," we have revised the superelevation and widening standards and copies of these standards are attached for your use and information.

Our widening and superelevation standards are built up from a combination of calculations, actual tests of various vehicles on various degrees of curvature, and general observations to meet the requirements for traffic safety.

Copies of their revised standards are shown herewith.

H. E. Surman, engineer of design, Illinois Division of Hignways, upon request forwarded a set of their tables and stated,

These tables were furnished us by J. T. Voshell, U. S. District Engineer, and we think the amount of widening is based on the following formula:

$$W = 2(R - \sqrt{R^2 - L^2}) + \frac{35}{\sqrt{R}}$$

in which L equals wheel base of vehicle, W equals widening in feet.

Mr. Voshell corroborated this, stating that the above formula was for widening of a two-lane pavement, that $\frac{35}{\sqrt{R}}$ is an empirical quantity selected as a result of observation and experience because drivers of motor vehicles do not drive a uniform distance from the edge of the pavement on curves with the same certainty as they do on tangents. "The total widening for a single lane pavement may be written as follows:

$$W = R - \sqrt{R^2 - L^2} + \frac{17.5}{\sqrt{R}}$$

"This formula is intended for widening on country roads and may not properly apply on streets in cities."

The Illinois tables affect both sides of the roadway; unevenly, however, which makes its use a bit unwieldly on street design where a grade line is laid for each side of the street. A spiral on the center line is affected, which is desirable, but the additional width, it is believed, is just a little deficient, although the table is well worth a lot of study and on highway curves of longer radii will be quite satisfactory. The writer was trying to arrive at conclusions for use in extreme cases on streets.

Taking the data from the Illinois tables for a 200 ft. center line radius and comparing with the California Division of Highways tables, the inside of the transitions are almost identical, while the outside of the California curve is not moved, thereby obtaining additional width where needed.

In the opinion of the writer, the California data and formulae are the most flexible, more rapidly calculated and staked of any yet found.

The California table shows 4 ft. additional width with 200 ft. radius and 2 ft. additional width with 400 ft. radius, therefore a formula may be written W equals 800/R with a maximum of 4 ft., but 150 ft. is the shortest radius shown. Using the above formula with R equals 150 ft. gives W as 16 ft. which is evidently excessive.

When coming to a curve as sharp as 50 ft. center line radius the vehicle must necessarily reduce speed and it is the opinion of the writer that by using the transition as per the California formula and the additional width as per the Missouri tables, the ultimate in traffic safety will have been taken care of by the designer.

A complete set of standards showing scheme of widening, sight distance and vertical curve formulae was received in the "Project Engineer's Manual"

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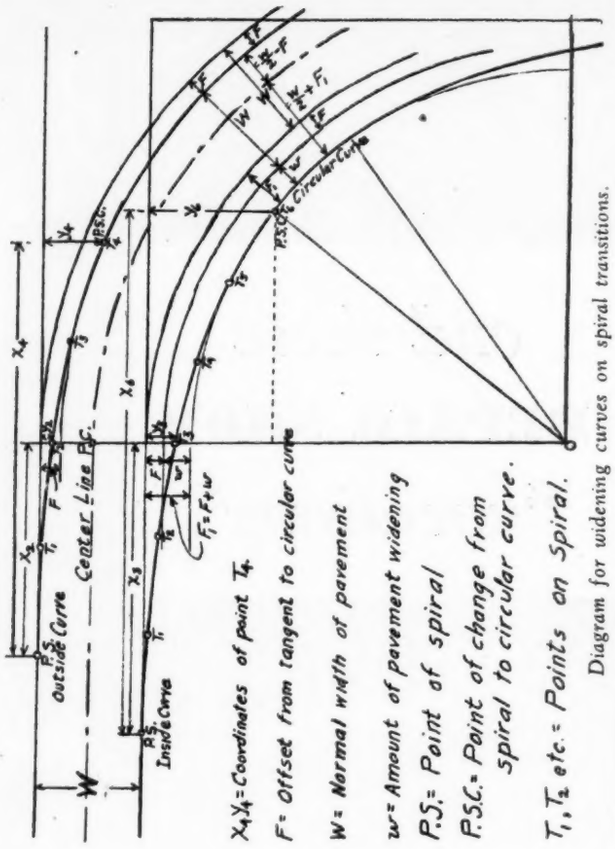

Outside Curve
Center Line P.C.
Inside Curve
P.S.
P.S.C.
Circular Curve
W
F
X4 Y4 = Coordinates of point T4
F = Offset from tangent to circular curve
W = Normal width of pavement
w = Amount of pavement widening
P.S. = Point of spiral
P.S.C. = Point of change from spiral to circular curve.
T1, T2 etc. = Points on Spiral.

Diagram for widening curves on spiral transitions.

NOTE: The tables give figures for center line curves at 10-foot intervals from radius of 200 feet to radius of 1,000 feet. Only the headings and figures for the longest and shortest radii are given below.

Outside Curve

Radius center line R	Radius outside curve R_o	Degree outside curve D_o	Length of spiral L_s	Offset from tangent F	Spiral angle S_e	COORDINATES TO OUTER EDGE OF ROAD Point T_1 X_1	Point T_1 Y_1	Point T_2 X_2	Point T_2 Y_2	Point T_3 X_3	Point T_3 Y_3	Point T_4 X_4	Point T_4 Y_4
200	210	27.29	100	1.98	13.64	25.0	.12	50.0	.99	74.9	3.3	99.4	7.9
1,000	1010	5.67	150	.93	4.25	37.5	.06	75.0	.46	112.5	1.6	149.9	3.7

Inside Curve

Radius center line R	Width W	Total offset from Tangent F_1	Radius inside curve R_i	Degree inside curve D_i	Length of spiral L_s	Spiral angle S_e	COORDINATES TO INNER EDGE OF ROAD Point T_1 X_1	Point T_1 Y_1	Point T_2 X_2	Point T_2 Y_2	Point T_3 X_3	Point T_3 Y_3	Point T_4 X_4	Point T_4 Y_4	Point T_5 X_5	Point T_5 Y_5	Point T_6 X_6	Point T_6 Y_6
200	3.0	4.98	190	30.16	151.7	22.87	25.3	.09	50.6	.75	75.9	2.5	100.8	6.0	125.4	11.7	149.3	20.2
1,000	2.0	2.93	990	5.79	264.0	7.64	44.0	.05	88.0	.43	132.0	1.5	175.9	3.5	219.8	6.8	263.5	11.7

Widening Curves by Using Cubic Spiral Transitions

Tables have been prepared to remove necessity of calculating in widening curves. These spirals can be used provided the spiral central angle is equal to or less than one-third of the total internal angle.

The coordinates XY of the various points T on the curve are measured along and from lines tangent to the inside and outside edges of the pavement, respectively.

In the field the spiral should be laid out as follows: For the outside spiral—At the P. C. of the outside edge of the pavement, offset Y_2. Measure back from this P. C., along the tangent, the distance X_2 and thus establish the P. S. Measure forward along this tangent from the P. S. the distance X_1 and offset from this tangent the distance Y_1, which establishes the point T_1 on the curve. The points T_3 and T_4 are established in a similar manner.

For the inside spiral—At the P. C. of the inside edge of the pavement, offset Y_3. Establish the P. S. by measuring back along the tangent the distance X_3. Then points T_1, T_2, T_4, T_5 and T_6 on the inner spiral are established as described for the outside spiral.

Repeat these processes for the spirals at the other end of the curve.

The circular part of the outside edge of the pavement can then be established by offsetting from the center line curve a distance equal to $\frac{W}{2} - F$; and the circular part of the inside edge by offsetting from the center line curve a distance equal to $\frac{W}{2} + F_1$

State of California, Department of Public Works, Division of Highways

CURVE WIDENING TABLE FOR 20 FT. PAVEMENT

R	W	R_n	R_w	R_t	D	D_2	x	y	be	ba_1	a_1e	ba	bf	m	m_1	m_2	m_3
150	4.0	140	136	300	12°40$^{52'}$	6°20$^{41'}$	30°07′	15°31½′	34.51	37.36	66.26	36.00	33.13	1.84	0.46	0.11	0.03
200	4.0	190	186	400	11°05$^{72'}$	5°32$^{80'}$	26°01½′	13°39′	39.83	42.38	77.34	41.18	38.67	1.88	0.47	0.12	0.03
250	3.5	240	236^{5}	500	9°20$^{84'}$	4°40$^{47'}$	23°25′	13°09′	41.87	43.95	81.50	42.80	40.75	1.67	0.42	0.11	0.03
300	3.0	290	287	600	7°56$^{85'}$	3°58$^{17'}$	21°40′	13°01½′	42.66	44.37	83.08	43.23	41.54	1.44	0.36	0.09	0.02
350	2.5	340	337^{5}	700	6°43$^{90'}$	3°22$^{00'}$	20°32¼′	13°14¼′	42.26	43.66	82.22	42.50	41.11	1.21	0.30	0.08	0.02
400	2.0	390	388	800	5°38$^{57'}$	2°49$^{43'}$	19°58¾′	13°51¼′	40.62	41.76	78.82	40.54	39.41	0.97	0.25	0.06	0.02
450	2.0	440	438	900	5°19$^{00'}$	2°40$^{00'}$	18°50½′	13°06½′	43.03	44.09	83.75	42.94	41.88	0.97	0.24	0.06	0.02
500	2.0	490	488	1000	5°03$^{90'}$	2°31$^{95'}$	17°53¼′	12°28¼′	45.28	46.33	88.39	45.21	44.20	0.98	0.24	0.06	0.02

through the courtesy of D. B. Levi, engineer of construction, Missouri State Highway Department.

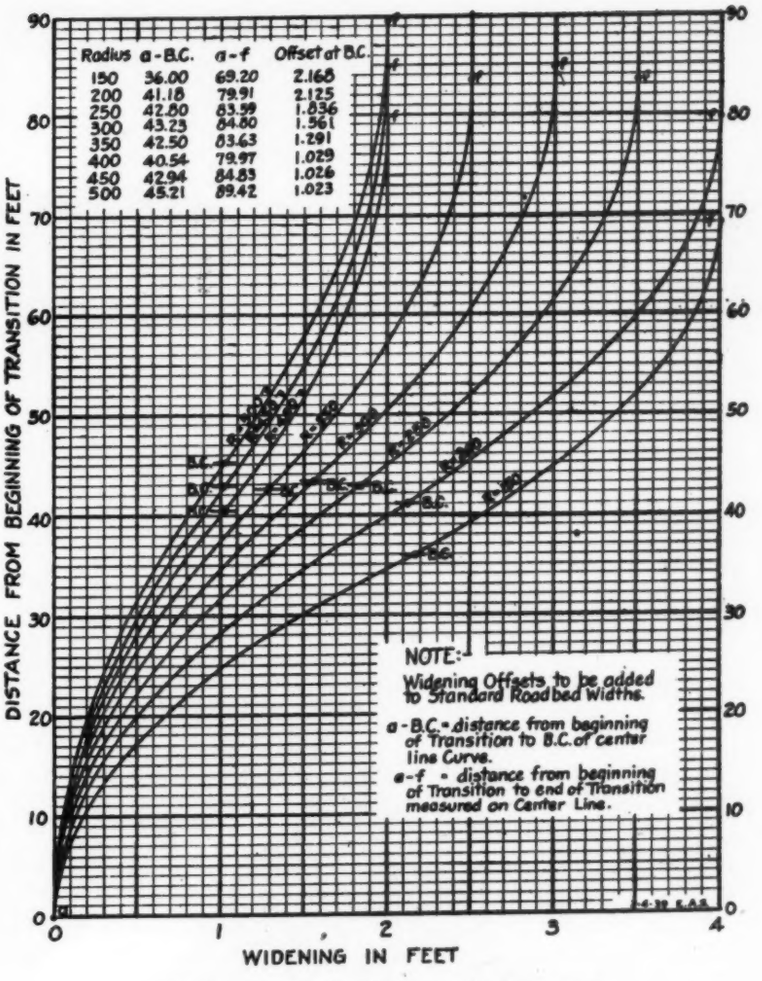
The City of Detroit uses the same radius on the sides as on the center line, which scheme has been used by the writer and found rather unsatisfactory as it results in unused width on the outside of the curve and is unwieldy in the design for superelevation.

It is hoped that tests may be made by the writer for extreme cases in the near future and the results tabulated and published for the information of those interested in this subject. Calculations are now being made by the Bureau of Engineering, City of Los Angeles, with the idea of spiraling the center lines of the curves of longer radii and then throw these spirals (with corrected chords) to the curb lines. Conclusions cannot be drawn from these calculations as yet, due to their not being entirely completed.

Blueprint of a scheme of widening and superelevation as used on the Blackfeet Highway near Glacier National Park by the Montana State Highway Department and data from the Bureau of Public Roads, District 1, 1925 are also given herewith for information and comparison. The Montana widening is quite onerous to stake and tedious to handle in the field.

The writer will welcome a discussion of this article by the many readers of PUBLIC WORKS and any data given will be appreciated.

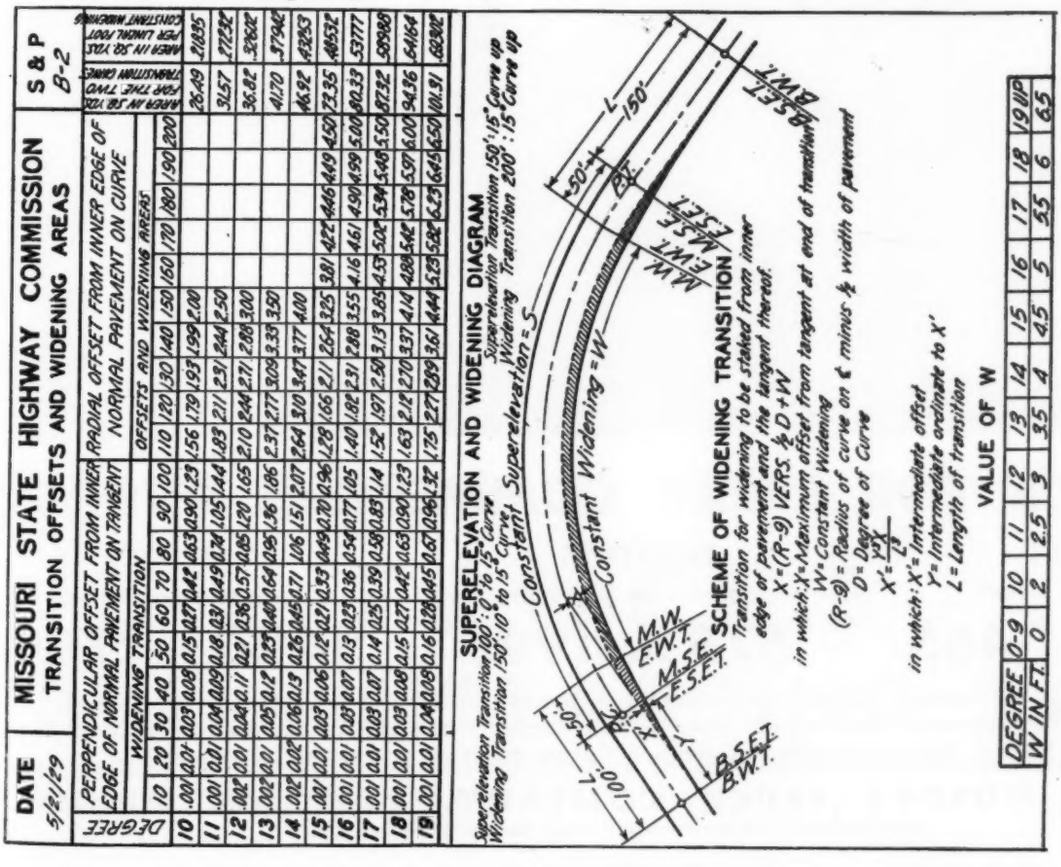
(*Continued on Page 74*)


Radius a-B.C. a-f Offset at B.C.
150 36.00 69.20 2.168
200 41.18 79.91 2.125
250 42.80 83.99 1.836
300 43.23 84.80 1.561
350 42.50 83.63 1.291
400 40.54 79.97 1.029
450 42.94 84.83 1.026
500 45.21 89.42 1.023
NOTE:
Widening Offsets to be added to Standard Roadbed Widths.
a-B.C. = distance from beginning of Transition to B.C. of center line Curve.
a-f = distance from beginning of Transition to end of Transition measured on Center Line.
DISTANCE FROM BEGINNING OF TRANSITION IN FEET
WIDENING IN FEET

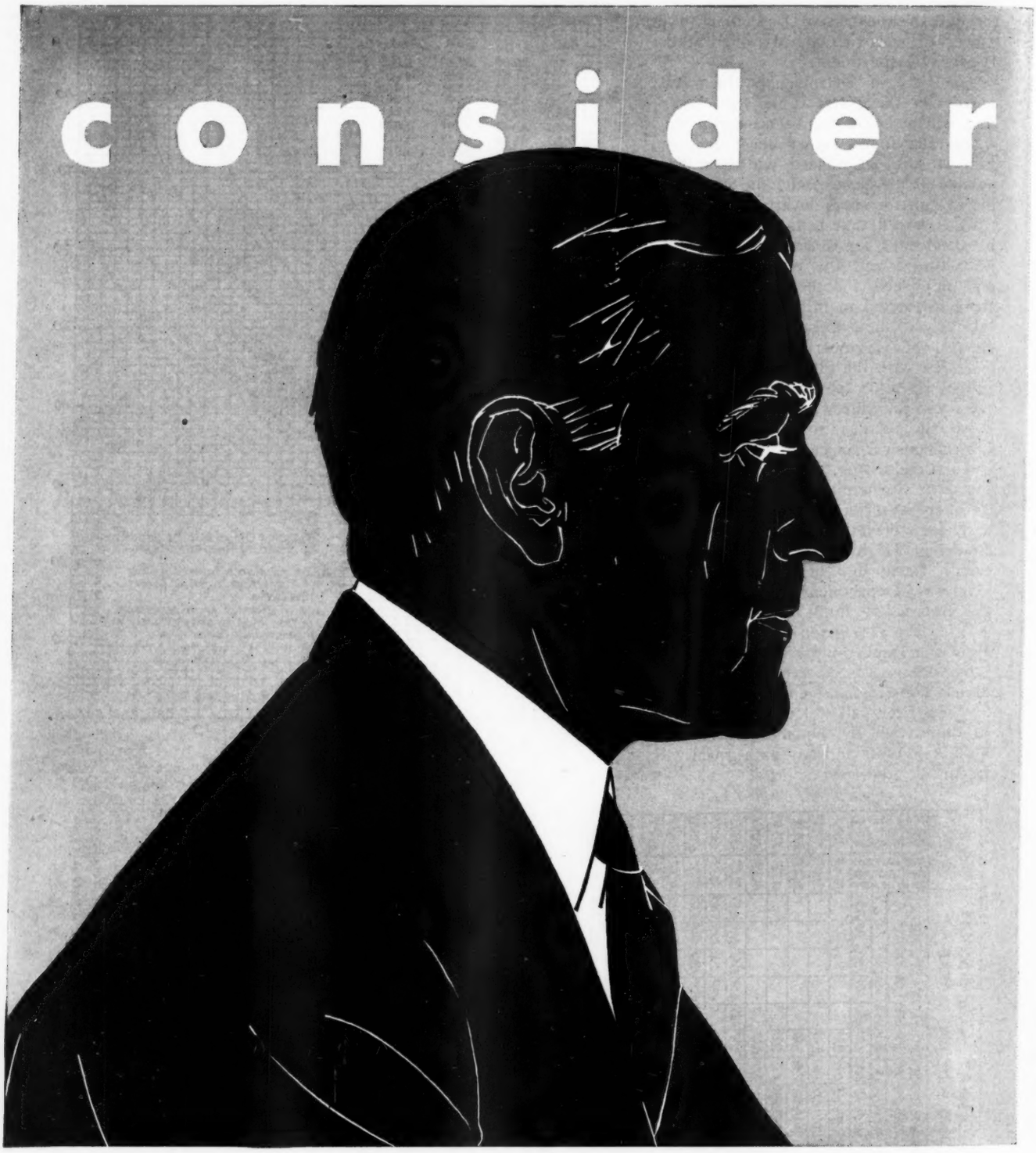
Standard curve widening, Montana Highway Dept.

DATE 5/21/29	MISSOURI STATE HIGHWAY COMMISSION TRANSITION OFFSETS AND WIDENING AREAS	S & P B-2

DEGREE	PERPENDICULAR OFFSET FROM INNER EDGE OF NORMAL PAVEMENT ON TANGENT	RADIAL OFFSET FROM INNER EDGE OF NORMAL PAVEMENT ON CURVE																AREA IN SQ. YDS. FOR ONE TWO TRANSITION CURVES	AREA IN SQ. YDS. PER LINEAL FOOT CONSTANT WIDENING
	WIDENING TRANSITION	OFFSETS AND WIDENING AREAS																	
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200		
10	.000	.00	.00	.00	.00	.01	.02	.04	.06	.08	.10	.13	.16	.19	.22	.25	.28	.32	.36	.40	26.49	.01895
11	.001	.00	.00	.00	.01	.02	.03	.05	.07	.09	.12	.15	.18	.21	.25	.29	.33	.37	.42	.46	31.57	.01752
12	.002	.00	.00	.01	.01	.02	.04	.06	.08	.11	.14	.17	.21	.24	.28	.33	.38	.43	.48	.53	36.82	.01622
13	.002	.00	.01	.01	.02	.03	.05	.07	.10	.13	.16	.20	.24	.28	.32	.37	.42	.48	.53	.59	41.70	.01740
14	.002	.00	.02	.02	.03	.04	.06	.09	.12	.15	.19	.23	.27	.32	.36	.42	.47	.53	.59	.65	46.92	.01783
15	.001	.00	.01	.02	.03	.05	.07	.10	.13	.17	.21	.25	.30	.35	.40	.46	.52	.58	.64	.71	52.35	.01852
16	.001	.00	.01	.01	.03	.05	.07	.10	.14	.18	.22	.27	.32	.37	.43	.49	.55	.61	.68	.75	57.87	.01933
17	.001	.00	.01	.01	.03	.05	.07	.10	.14	.18	.23	.28	.33	.39	.45	.51	.58	.65	.72	.79	63.48	.01977
18	.001	.00	.01	.01	.03	.05	.08	.11	.15	.19	.24	.29	.35	.41	.47	.54	.61	.68	.76	.84	69.16	.02032
19	.001	.00	.01	.01	.04	.06	.08	.11	.15	.20	.25	.30	.36	.42	.49	.56	.63	.71	.79	.87	74.91	.02082


SUPERELEVATION AND WIDENING DIAGRAM
Superelevation Transition 200':5% to 15° Curve
Widening Transition 150':0 to 15° Curve
Superelevation Transition 200':15° Curve up
Widening Transition 200':15° Curve up
Superelevation = S
Widening = W
Constant Superelevation
Constant Widening
SCHEME OF WIDENING TRANSITION
Transition for widening to be staked from inner edge of pavement and the tangent thereof.
X = (R-9) VERS. ½ D + W
in which: X = Maximum offset from tangent at end of transition
W = Constant Widening
(R-9) = Radius of curve on ℄ minus ½ width of pavement
D = Degree of Curve
X' = X·x/L
in which: X' = Intermediate offset
x = Intermediate ordinate to X'
L = Length of transition
VALUE OF W
DEGREE 0-9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 UP
W IN FT 0 | 2 | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 | 5.5 | 6 | 6.5
M.W.
E.W.T.
M.S.E.
E.S.E.T.
B.S.E.T.
B.W.T.
L
150'
50'
100'
X
x
BC
EC

Transition offsets and widening areas, 18-foot pavement. For 20-foot pavement, substitute 10 for 9 in the formulas; but the table is sufficiently close for either width. The length of constant widening, when using the area per foot, is measured on the center line of the survey and not on the center line of constant widening; the difference has been taken into consideration.



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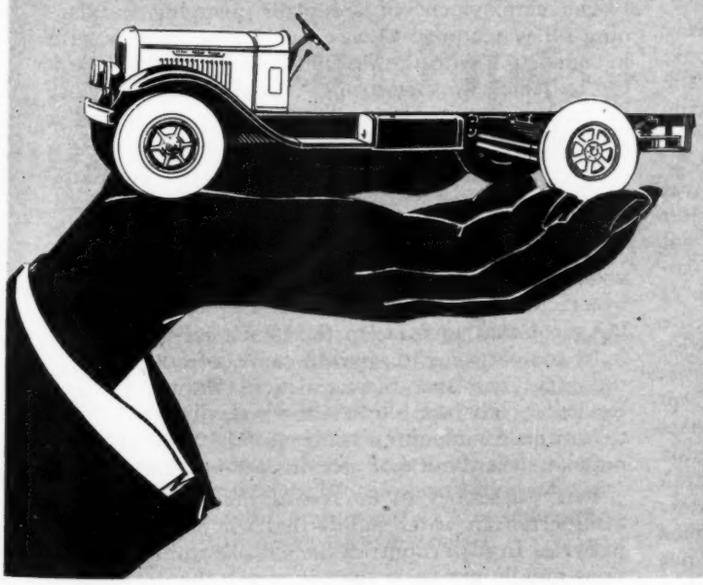

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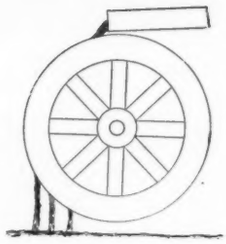
THE WATER WHEEL



By
Jack J. Hinman, Jr.

The essential features of important articles of the month having to do with water works design, construction and operation and water purification, arranged in easy reference form and condensed and interpreted by a leader in the water works field. Published every month to include articles appearing during the preceding month

DESIGN

NEW water laws are in the making, in the opinion of Stevenson and Ryder[20] after a consideration of the recent decisions of the Supreme Court in the cases of the water supplies of Boston and New York. Neither the riparian nor the prior appropriation principles were directly applied in these instances. The basis of the rulings was **equitable apportionment without substantial damage.** Undoubtedly the recent decisions will have an important bearing on the location of water supply sources where interstate waters are under consideration. This may even be so in the development of supplies much smaller than the huge supplementary supplies in course of development for New York City[n12]. In the Western states, except California, the **doctrine of prior appropriation** has generally been used. Conkling[93] discusses the relationship of this doctrine to the development of agriculture in Colorado and shows the need, in areas deficient in water, for a more satisfactory system than the old riparian laws.

American practice in the **construction of dams** was reviewed by Saville[81] for the benefit of British water engineers. American design for **earth-fill dams** is not the same as that which German engineers have employed[40]. **Earth,** itself, though a basic material of construction, has received very little study, and the laboratory methods which are available for determining the characteristics of the different soils are surprisingly little known[23]. The **safety of the Hoover Dam** design having been criticized, Westergaard[22] insists that the dam will be satisfactory as an arch dam, while Mead[21] finds the dam amply strong both as an arch dam and as a gravity dam. The **Prettyboy dam** near Baltimore on the Gunpowder river has been modified in design because a large amount of **poor rock** in mica schist was unexpectedly found at the dam site[43]. The No Town dam at Leominster, Mass., was reconstructed at a cost of about $26,500[69].

The **danger of blocking the spillways** of dams and of the insertion of flashboards has been pointed out by Bell[29]. These flashboards are easy to remove in dry weather—but not in flood time. Sudden rise of streams following cloudbursts on their watersheds might cause the dams to go out. Studies on the **maximum rates of precipitation** in short periods of time, such as that of Reed[75] for Iowa, become important in this connection. The greatest recorded rate for Iowa was 0.66 inch in 5 minutes, or a short fall at a rate of 7.92 inches per hour.

The laws of the state of New York require that a large amount of air per man shall be supplied in **tunnels** during construction. Kelley and Ross[27] tell how this air was secured during the construction of the new 20-mile water tunnel for New York City.

In the design of water plants for cities in **arid and semi-arid regions** of the southwest, serious error will be met unless the tremendous consumption of water for sprinkling and irrigation during hot dry weather is provided for. The quantity used for these purposes was estimated at thirty gallons per 100 square feet of lawn per day during such weather conditions in Tucson. This amounted to 64% of the pumpage. N. T. Veatch, Jr., has collected a large amount of design data covering irrigation and sprinkling use[50].

The employment of **aeroplane mapping** in planning for water projects was found to be most helpful in connection with the Prettyboy dam project, according to James W. Armstrong[15]. It enabled surveys to be made without advertising the city's needs and it showed up inaccuracies in existing maps.

The determining of the **population of communities** in off-census years is commonly accomplished: 1. by comparing known quantities with past years in such items as numbers of school children, number of voters or numbers of water services and multiplying by a factor; 2. by compound interest procedures, assuming a constant increase in the increments of growth; 3. by comparison with growth curves of other cities of the same size and characteristics. Brown, of New Rochelle[3], has used the last method, though he finds that in his communities, which are 100% metered, the population is about **6.58 persons per meter.**

Parr[58] describes an interesting method of securing a subterranean water supply that has been developed in Syria. In such countries the streams from the mountains rapidly dry up as they approach the desert plain. By putting down a **line of wells** leading from the mountains and connecting the bottoms of the wells, water can be led to the point desired with evaporation losses much reduced.

Prospecting for a ground water supply involves many types of inquiry. Simpson[91] enumerates these and discusses their value. Movement[46] and collection of ground waters in the earth[48] have been considered by Maynard and by Mezger respectively. Burwell[88] has found that a **canalized river,** subject to controlled rise and fall, has a definite effect on shallow wells located 350 feet from the river bank. **Concrete lining of irrigation canals** by the gunite process has been found to cost about 15 or 16 cents a square foot under certain Texas conditions[28]. This amounts to about $6,500 per

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mile for a canal capable of carrying 15 to 20 cubic feet per second.

British practice in **sinking of borings** is described by Hetherington[82]. Williams[56] has made a valuable study of the **capacities of wells,** with especial reference to wells in sands and gravels.

Macaulay[83] has begun to publish an article dealing with the construction of modern **water mains** in British practice. Cast iron, steel, reinforced concrete and other types of piping are discussed. The uncovering of a water main laid in 1817 in Philadelphia[55] was followed by the removal of a section of 90-year-old pipe in New York City[n2, n96]. Both mains were in good condition. Canajoharie, N. Y.,[n44] has received a bid of $25,890 for laying 8 miles of 8 and 10-inch cast iron pipe. Ashton[71] urges the use of **wrought iron pipe,** now more readily available than formerly. Cleveland[45] asked for bids on four types of steel pipe of 48 inch and 54 inch diameter and for 24 inch cast iron pipe. Brush[53] notes two instances of **failures of small patches** in large steel pipe where test coupons had been removed. Cooling stresses in welding in the material used to close the opening between two sections not free to move were apparently responsible. Patches are now riveted in.

Copper and brass pipe and their use in water systems forms the subject of a paper by Schneider[54]. He claims that water with 5 parts per million of copper tastes so badly that it is virtually impossible to drink the water. However, even after standing some time, acid water, with a pH of 6.5, takes up only about 0.5 part per million of copper from copper piping. A bibliography on the effect of **copper on health** and approved specification data are included.

Solution of **dual flow problems** in branching mains by graphical methods is explained by Palsgrove[52, 90]. Giesecke and Badgett[25], studying the **friction losses in 1 inch standard cast iron tees,** found that when all of the water flows from one branch the losses are at a minimum, but that the friction greatly increases as the proportion diverted through the branch is reduced by allowing flow through the other branch. A. T. Clark[n95] has devised a monograph which he calls the **"Flow Powergraph"** and which extends the information regarding pipe friction found by the Hazen-Williams formulae to give loss in terms of theoretical horsepower per 1,000 feet of pipe.

In their discussion of the **design of the piping** for the Western Avenue pumping station in Chicago, Carlisle and Kennedy[49] tell of a new type of check valve employed.

Construction

The water softening plant at **Boca Raton, Florida**[60], is a very small but very complete plant. **Lachine, Quebec**[n37], expects to erect a filter plant with a capacity of 6,600,000 gallons at a cost of about $400,000. The new Hannacrois-Basic-Catskill water supply for **Albany, New York,** is described at length by Horton and Smith[64]. Two basins of the Compton Hill Reservoirs, at **St. Louis,** about 415x502 feet each, are to be covered with reinforced concrete roofs. The low bid was $222,440[n35]. Work on the Eleven Mile Canyon Dam at **Denver** is about a year ahead of schedule and will be complete in 1931. A dam 140 feet high impounds water in a lake 6 miles long and 1½ miles wide at a cost of about $1,000,000[n34]. An emergency Hetch-Hetchy pipe line over the Coast Range to **San Francisco** is planned[n41]. It will be 25.9 miles long and have a total lift of 1,325 feet. The capacity will be 45 million gallons per day and the cost about $1,850,000. The Madden reservoir[39] on the Chagres river in the **Panama Canal Zone** will greatly increase the water supply and power facilities of the Canal Zone. Salt Lake City approved a $2,000,000 bond issue to increase the water supply on July 1st. The vote was about 2:1 in favor of the expenditure[n31]. On September 29th the voters of the cities in the **Metropolitan Water District of Southern California** will decide the fate of a $220,000,000 bond issue[n42]. This does not represent the total final cost of the great project.

Operation

The **details of operation** of a water works plant involve many different phases of endeavor. W. W. Brush[70] briefly discusses some of the numerous problems in the operation of a very large supply, such as that of New York City, with which he is connected. In discussing the practical operation of **water works pumps,** Greene[68] concerns himself chiefly with a consideration of various **priming** arrangements and conditions. **Diesel engines**[n100] are installed in plants at Duxbury and Marshfield, Massachusetts, and at Salem, New Hampshire.

The great artesian aquifer in **South Dakota**[61] is the Dakota sandstone. There are, however, a few surface water supplies. Wells yield water which is highly mineralized. Supplies frequently exceed 2,000 parts per million of total solids. The waters are usually bacteriologically good, but they are corrosive to casing metal. The water supplies of **West Virginia** are listed in a recent bulletin of the State Department of Health of West Virginia[77]. Details of the equipment of the plants are given, together with remarks about the experience of the locality during the recent drought.

When attending a meeting of British water engineers, E. Sherman Chase[80] gave a concise review of **current water works practice in the United States.** Naturally, a considerable portion of his remarks concerned water treatment. At the First Arkansas Water Works Operators' Short Course a general paper on the **operation of rapid sand filters** was given by A. H. Ulrich[18]. Small filter plants have operating difficulties every whit as important to the communities served as are the difficulties of large installations. At Madison, West Virginia, the difficulties of operation during the past year have included red water, chlorine tastes, algae, and extreme water shortage[103]. Current methods of attack were usually successful in improving the taste situation.

The theory of **sand expansion index** as developed at Detroit is explained by Hulbert[92]. The investigation of the **characteristics of filter sands** which has been carried out under the direction of James W. Armstrong[87] has indicated that too fine sands have apparently been used in most filtration of conventional rapid sand type. Early experiments were conducted in narrow glass tubes, (or in glass tubes of six inches diameter at Detroit[n32]), but larger scale work substantiates the results indicated in the miniature units. These two investigations will probably change rapid sand filtration practice—as distinguished from preparation of water for filtration—more profoundly than any other recent work.

In connection with the operation of the **water softening plant** at Bloomington, Illinois[57, 104], it was noted that the algae in the water were removing carbon dioxide from the calcium bicarbonate and precipitating the normal carbonate. The reducion in alkalinity was from 234 to 194 parts per million and effected a saving in lime of $6.00 per day, until the river rose. **Lime** is being manufactured on a larger scale in Canada[n16].

However lime is imported from, as well as exported to, the United States. The Southern Pacific Railroad has 31 **zeolite water softening plants** erected at a cost of from $5,000 to $20,000 each[78]. If it is estimated that the saving in boiler maintenance and repair is at the rate of ten cents per pound of scale-forming minerals removed, these plants each produced an average annual saving of $19,000. **Water softening by electro-osmose** by Bartow and Jebens[74] produced water with less than 15 parts per million of solids from water originally containing 725 parts per million.

Iron in the water supply of Platte City, Missouri[4], amounted to about 40 parts per million. It was easily removed by aeration and filtration. **Manganese** in waters resembles iron in many ways, but it is slower to oxidize and precipitate and hence is harder to remove. Weston[112] believes that surface aeration and contact with accumulations of the hydrated oxides is better than treatment with alkalies, where manganese is annoying.

In discussing **recent developments in chlorination,** West[65] mentions four theories to account for the action of the chlorine on bacteria. These are: 1. Leaf's nascent oxygen theory; 2. Phelp's direct toxic action theory; 3. the formation of chloramines; 4. Bunau-Varilla's ultra violet ray theory. A paper by Baylis[110] suggesting irreversible coagulation as the **cause of death of the bacteria** should be consulted as adding information of even later date.

Taste and odor control continue to attract much attention because of the immediate flood of complaints which reach the water office when any unpleasant odor and taste develop in a water supply. Hansen[94] contributes a paper on the state of the art of taste and odor removal. Remedies which are successful in one locality and at one time may fail if tried at another plant or at the same plant under different conditions. Lyles[84] found the ammonia-chlorine treatment effective in removing medicinal tastes from the water supply of **Tampa, Florida.**

Corrosion of piping in ground which attacks the exterior of the pipe, or corrosion by the water carried which attacks the inner surface, must both be fought by water works men[72, 17]. Work by the U. S. Bureau of Standards on pipe lines in Texas, Oklahoma and Kansas, has shown that there is—at least in those localities—a definite connection between external pipe corrosion and **soil conductivity**[n36]. Apparatus has been devised for the measurement of the soil conductivity at the level of the pipe. **Protective coatings**[73] are used against both internal and external corrosion. **Lime** in amount sufficient to bring the pH of filtered waters to a value of 8.0 to 8.3 has been used to reduce the corrosive effect of Baltimore water, according to Hopkins[108].

The **Committee on Water Works Practice** of the American Water Works Association has published a report of the highly varied types of study which have been conducted under its direction by many agencies[59]. In reply to a criticism that water works meetings were devoting an excessive amount of time to discussion of problems of water treatment, Harry E. Jordan[n33] explains the efforts which have been made to maintain a proper balance in water works papers and notes as well the great apparent interest of water works operators in discussions of water purification as shown by the large numbers attending these special sessions.

Management

Frank C. Jordan's[19] valuable paper on eliminating **water works losses** was published again. Wheeler[n101] attacks the ideas of **false economy** which prevent many water works systems from being kept up to a sufficiently high degree of efficiency and in arrested stages of development that endanger continuity of service. Majeske[85] explains Detroit's experiment with the Probst service rating system and the hope that the **personnel studies** may improve the departmental teamwork and overall efficiency. Elyria, Ohio[n102] has experienced difficulty with the personnel problem as a result of the practice in use of allowing men to **work out their water bills** at 50 cents per hour. It has been difficult to find sufficient work. On one day they had 82 of these temporary employees. Symposia on securing **payment for water used in construction**[107] and on **rates and regulations (Part IV))**[5] have appeared. An equitable charge for **sprinkler fire protection services** is hard to secure. To the water works operator it seems obvious that the service should pay its own way, but the owner of the sprinkler system frequently objects to paying for connection without water use. L. R. Howson arrives at the conclusion that the ready-to-serve charge for a 2-inch connection should be about $40 to $60 per year, and for a 6-inch connection about $250 to $350 per year.

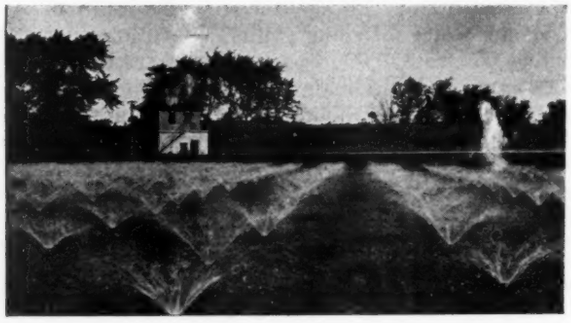
The city of **Elizabeth, N. J.,**[n38] has acquired the distribution systems of the Elizabethtown Water Company and the Plainfield Union Water Company. Water will be obtained from these two companies and from Newark. The **Delaware Valley Utilities Company** has purchased twenty-four water works properties from the National Water Works Company[n115]. The **California Water Service Company,** a subsidiary of the Federal Water Works Company, has purchased three plants formerly owned by the Associated Public Utilities Company[n97]. The **Passaic Valley Water Commission** has been empowered to pay for holdings of the old Passaic Consolidated Water Company and to carry out some construction work[n99]. The city of **Pasadena** lost its suit to stop the Sunny Slope Water Company from drilling wells in the Lombardy annex of the city. The suit was brought under the zoning ordinance[n98].

Laboratory

A general survey of the methods of study applied to **streams** which are polluted with sewage and industrial wastes has been prepared by Henderson, assistant state sanitary engineer of Georgia[86]. **New tables** of volume change, specific weight, pressure of water vapor and amounts of gases dissolved have been developed by Reuther[47]. The effect of **manganous salts** on the blank tests with raw waters by the orthotolidine method for the estimation of free chlorine is described by Enslow[105], who proposes a method for avoiding the errors involved. E. L. Filby, of Florida, has used an old phonograph as a table for **streaking** eosine methylene blue agar plates in the confirmation tests for organisms of the colon-aerogenes group. The spiral streak which is obtained is believed to permit more separated colony development[6]. The annual statistics on **typhoid fever** in the cities of the United States[63] prepared by the American Medical Association showed that, of 93 cities of over 100,000 population in the country, 10 had no deaths from typhoid fever, 55 had from zero to 1.9 deaths per 100,000, 30 had from 2 to 4.9, 6 from 5 to 9.9, and only two over 10 deaths per 100,000. In Indiana it was held that the widow of an employee of the state highway commission who died as a result of

(Continued on page 62)

Sewerage and Sanitation



The Treatment of Canning Wastes

Studies on the treatment of canning wastes, conducted by the N. Y. State Department of Health in cooperation with the Association of New York State Canners, Inc., and several canning concerns indicate that canning wastes may be treated by methods similar to those used in the treatment of domestic sewage, although canning wastes are five to ten times as concentrated. The degree of treatment depends upon the available dilution of the treated wastes in the body of water receiving them. Screening through fine, mechanically operated screens is adequate when the final dilution is about 1 in 100 or greater. When the dilution is much less, the screen waste must be treated on trickling filters, or by chemical precipitation, using copperas and lime to coagulate and precipitate the organic solids. The rate of filtration, and hence the degree of treatment, depend upon the dilution. Lower rates are needed where the dilution is low and vice versa. Treatment of wastes by means of fine screening, filtration through trickling filters at a low rate, and final chlorination produces an effluent which may be discharged into a stream where the final dilution is only 1 in 5. Chlorination of the treated wastes aids in controlling odors and preventing the growth of molds and fungi in the stream below the outfall sewer.

In designing plants for the treatment of canning wastes it is advisable to secure the services of a sanitary engineer because the degree of treatment and the size of the installation depend upon many local conditions.

Detailed information on this subject is contained in a bulletin recently issued by the Division of Sanitation, State Department of Health, Albany, New York.

Electrocuting Dairy Barn Flies

What appears to be a promising method of controlling the fly pest in dairy barns is being developed by Donald L. Collins of Harvard University, at the New York State Agricultural Experiment Station, Geneva, New York.

Mr. Collins has utilized for his experiment, screen doors covering the three exists from the dairy barn to the barnyard. The upper panels of these screens are composed of copper wires woven alternately across an insulated frame work and spaced about one-fourth of an inch apart. The screens are supplied with a high tension static charge of electricity from a small transformer which produces a charge of approximately 3,500 volts and less than 0.05 milliamperes. The transformer operates on an ordinary 110-115 volt 60-cycle lighting circuit and draws less than 0.2 ampere, a charge harmless to human beings, but deadly to insects. When these doors are closed during the greater part of the day and night, the flies and other insects which attempt to enter the stable are instantly electrocuted. Since the doors must be left open, however, during the time the cattle are passing in and out of the barn, and while the stable is being cleaned, many flies gain entrance. After the doors are closed again, many of these insects may be driven against the wires from the inside by one of the repellent sprays now on the market for use on the walls and stalls and on the cattle themselves. As many as fifteen or twenty thousand flies have been killed on a warm summer day.

This method of fly electrocution is considered to be still in the experimental stage, but the fact remains that since the installation of the electrified screens the fly nuisance in the dairy barn has noticeably abated. —*New York State "Health News."*

Large Garbage Trucks Used in Jacksonville

"There is no question but that, where there is enough garbage to collect, motor trucks are the most economical and it is a mistake to use small trucks," said Dr. M. B. Herlong, commissioner of health and sanitation of Jacksonville, Fla., in a paper [illegible] International Association of Street Sanitation Offic[illegible] "The only lost motion in garbage collection is between the point where the load is completed and the point of disposal, so the fewer the loads the less lost motion and time."

In 1921 the cost per ton for garbage collection was $1.97, but it dropped to $1.56 in 1922 and $1.57 in 1923, due presumably to the change made in 1921 (when Dr. Herlong took charge of the department) from 1 and 1½-ton trucks to 2½ and 3-ton. Dr. Herlong said: "We found that the smaller trucks were being overloaded, resulting in unusually high tire expense. In fact, tire costs represented fifty per cent of the total truck upkeep. Then again, with the smaller trucks there was much lost time because more frequent trips were necessary, due to lack of sufficient capacity.

"In Jacksonville each driver is assigned to a truck. No one else uses it. Consequently the driver takes more interest in his truck. The city garage reports that this method, plus a systematic daily inspection, enabled us to reduce our garage expense for the first half of 1930 eleven thousand dollars below that for the first half of 1929.

(Continued on page 58)

HIGHWAYS and PAVEMENTS

Metal Removed from North Dakota Highways

In 1930 the Department of State Highways of North Dakota bought a magnetic road sweeper or "nail picker," furnished with a gasoline engine and generator and three magnets, one at the rear and one on each side in front of the rear wheels; the whole mounted on a one-ton truck. This covers a strip about 9 feet wide, and three trips are required to cover a 24-foot roadway. The truck travels about 6 miles per hour, cleaning 16 to 20 miles a day.

Last year the equipment cleaned 1,172 miles of gravelled highways at an average cost of $1.25 per mile "swept." Between April 9 and June 30 of this year it swept 1,235 miles. Last year it collected 13,891 pounds of metal, an average of 11.9 pounds per mile. This year it collected 11,194 pounds, an average of 9.06 pounds per mile.

Of course not all the iron and steel picked up was potential puncturing material, but inquiries at tire repair shops showed that the puncture repairing business dropped off 40 to 50 per cent after the nail picker had been along. The department estimates that the roads cleaned carried more than 100,000 vehicle-miles per mile in a year, giving the cost of cle[illegible]ss than 0.001 of a cent per vehicle-mile of tr[illegible]

Aerial Photographic Surveys for Highway Location

The Tennessee State Highway Commissioner has recently substituted aerial photographic surveys for some of the preliminary work in connection with location surveys. These aerial surveys have been contracted at a very reasonable price, and have not only improved the quality of the location, but have, in addition, saved enough field work to pay the cost of the photographic work.

In preparing for aerial survey, photographic pictures are taken from an airplane operating at a height of 12,000 feet, making photographs which scale approximately 1,000 feet to the inch. These photographs are taken with sufficient over-lap so that there are at least two photographs showing each point within the limits of the survey. These limits cover a strip varying in width from two to five miles between control points.

With the aid of a stereoscope and the over-lapping pictures, it is possible to determine with remarkable accuracy the topography of the country along these lines, and to either select the proper location or narrow the choice to a small number of routes which can be easily and very thoroughly investigated in the field. The drainage areas for bridges and culverts can also be determined more accurately from these photographs than by field surveys.

Removing Excess Filler from Pavement

On a road in the southwestern part of Ohio newly paved with brick, the excess of asphalt filler spread over the surface was found to become rather slick when wet, and on a superelevated curve midway down a steep grade a number of minor accidents had occurred because of this. To remedy this, the asphalt on the surface of the bricks was removed in the following manner, which was believed to be new. The pavement was first covered with a thin layer of sand to protect the brick from the gasoline flames of the pavement heater, which was used to burn off the asphalt. The heater was then run over the pavement, until practically all the asphalt had been burned off of the surface and for a slight distance down into the joints, four trips of the heater being required for this purpose.

Patching Concrete Pavements

By E. Fraser

To be invisible, concrete patches must be practically the same color as the original pavement and must not shrink enough to form cracks where they join the old slab. To accomplish this requires the use of cement, sand and coarse aggregate of practically the same color as those used in the original pavement; the use of a very dry concrete, and, finally, adequate re-tamping and curing. The following steps may be followed with assurance that the finished patches will be essentially invisible:

(1) Trim edges of the opening to be patched so that the top (2 in.) is practically vertical and the top edge is neither chipped nor rounded.

(2) Use materials of essentially the same color as those used in the original pavement, mixing the concrete so dry that mortar will just form a ball when the material is squeezed in the hand. Use well-graded 0 to ¼-in. sand and well-graded ¼ to 1½-in. coarse material. Mix the concrete two minutes in a batch mixer or turn ten times by hand. For temperatures of 60 deg. F. or above, use a 1:2:3½ mix for patches to be protected from traffic for five days; 1:1¾:3, for four-day protection; 1:1:2, for three-day protection.

(3) Place concrete in the patch, leaving it about one-half inch above the level of the surrounding pavement.

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McCormick-Deering Model 30 Industrial Tractor, 40 h. p. engine. Model 20 is similiar in design and has a 25 h. p. engine.

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(4) Tamp the patch thoroughly, using a 2 by 4 around the edges to press the new concrete firmly against the old. Then lay a plank of 2-in. stock over the patch, resting on the adjacent slab, and tamp on the plank with a 12-lb. tamp or its equivalent.

(5) Re-tamp the concrete patch three times at 15-min. intervals, or, if preferred, tamp it only once 45 min. after the first tamping. Either method will give satisfactory results.

(6) Strike off the patch with a straight-edge resting on the adjacent slab and held parallel to the center line of the pavement. Correct elevation is necessary for a successful patch—that is, the new concrete should be neither above nor below the level of the adjacent pavement.*

(7) Finishing is done with either a belt or a wood float; if possible, it is desirable to produce the same surface texture in the patch as exists in the old pavement.

(8) Place barricades to keep traffic off the patch.

(9) The last and most important step is to cover the patch with wet earth, keeping it wet until the patch is opened to traffic. This step insures proper curing and minimizes shrinkage.

*If either, it is better to have it a little high and grind it down to the pavement level after it has set.—EDITOR.

Liberty Solves Its Sewage Treatment Problem

(Continued from page 30)

Personnel

As stated before, the construction of new plant is possible largely because of the zeal and work of the chairman of the Board of Sewer Commissioners, E. Leslie Cooper, and the associate member, Dr. George H. Freer, who has since succeeded Mr. Cooper as chairman of the Board. Other members are Harold Poley and Paul Johansen. Members of the Village Board, who cooperated heartily in the campaign, included John Cessna, Village President, Walter Randall, Ross Tompkins, Ernest Hoos and Edward Hallenbeck. During the interim, Mr. Hallenbeck has succeeded Mr. Cessna as Village President, and H. Nelson Krum has been added to the Board. Theo S. Kessler is village clerk. Harold O. Weyrauch is resident engineer.

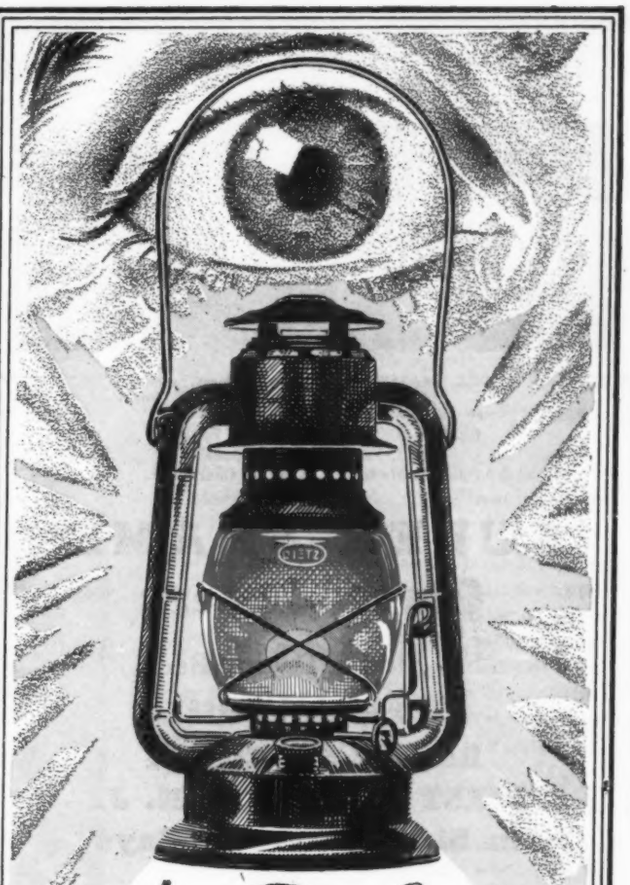
Oil Power Plant Cheaper Than Steam to Operate

(Continued from page 32)

hour and 55 minutes, and the total cost for repairs has been $275.

An average of 140,000 kw. per month is placed on the board at an average cost of 0.85 cent, including all expenses for salaries, repairs, etc. When the old plant was operating the cost was nearly 5 cents. This and efficient management have permitted reducing the rates several times. The present rate, lower than that in the surrounding territory, is 8 cts. for the first 50 kw. and 7 cts. beyond that; with a power rate of 5 cts. for the first 300 kw., 3¼ cts. for the next 5,000, and 2½ cts. beyond that. Refrigeration is 4 cts. The minimum for each is $1.00 a month.

The building which houses the plant, constructed new for that purpose at the edge of the city, is 50x85 feet, of red brick with a concrete slab roof. The surrounding ground has been landscaped. The interior is kept clean and both machinery and building are painted frequently.



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DIETZ RED LANTERNS

CAN you think of any lights along the road that are so universally understood—so certain to induce cautious driving—as those furnished by Dietz Red Lanterns?

That is one reason for the world wide use of sure burning Dietz Lanterns in night warning service on road construction. Another reason is—LOW COST.

Specify Dietz Red Lanterns for economical protection of general traffic and your own interests.

USE RED No other color means DANGER

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Largest Makers of Lanterns in the World

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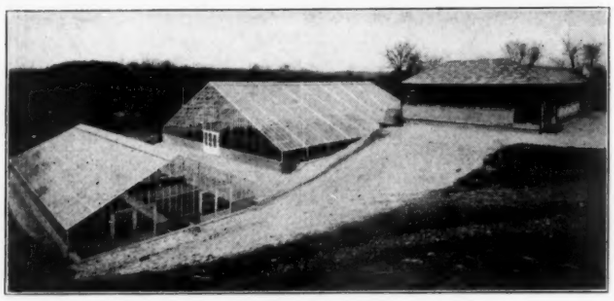


SUPER-FRAME Glass Covers at West Paterson, N. J. Sludge Bed in the foreground. Spray House in rear.
Charles H. Capen, Consulting Engineer
H. J. Harder, City Engineer
John W. Heller Co., General Contractor

SUPER-FRAME Glass Covers

For Sludge Drying Beds and Spray Houses

Benefit the City of WEST PATERSON, N. J. In Six Important Ways

1. The plant has four to five times the capacity of similar plants without glass covers.
2. Much less ground space was required for the plant.
3. Breeding of flies and mosquitoes has been prevented.
4. Rain and snow do not interfere with drying and other operations.
5. The sludge is hidden from view and odors are confined.
6. Property values in the vicinity are less affected by the presence of the plant.

Of Particular Value to Smaller Towns

WE INVITE members of the Sewage committee and engineers to:—

Use the services of our experienced engineers who are always available when sewage disposal plant improvements are being considered.

Call on us to submit plans and specifications on covers for your existing or proposed sludge beds and spray houses.

Send for our Engineers Folder which gives plans and specifications of typical SUPER-Frame glass covers for sludge beds and spray houses.

Hitchings & Company

General Offices and Factory
Elizabeth, N. J.

BUILDERS OF GLASS STRUCTURES SINCE 1870

Sewage Treatment for the Smaller Community

(Continued from page 20)

erally by evaporation and drainage on sand beds. It is then no longer objectionably odoriferous, contains no dangerous bacteria, and may be used for fertilizer, for fill, or for other purposes.

Uncovered sand beds are subject to rain, cold weather, and other factors which prevent them from drying sludge at the rate and in the manner intended. It has therefore become the usual practice to cover these beds with glass enclosures, similar to greenhouses. Not more than half as much area is required for a covered as for an uncovered bed, so that there is no net cost for covering, and this facilitates the regular operation of the plant by eliminating the hazards due to weather conditions, and lends an attractive appearance to the disposal grounds.

Landscaping the Grounds

An important factor, which is being widely recognized at the present time, is that of making the disposal grounds attractive. The day is past when the sewage treatment plant can be tucked in a far-off corner and forgotten. It must be well-operated; it should be made attractive and kept so. If this is not done, and if the taxpayers are not made to realize that one of the important functions of the community is to dispose of its own wastes, they will not readily furnish money for new plants, or for improvements and extension to the old plant. Likewise it will be difficult to maintain a trained operator and to protect the community's investment in its plant. In too many places a plant which has cost the community thousands of dollars is poorly operated and hidden in weeds, a disgrace to the town as well as a waste of its investment.

Improving and Remodeling Old Plants

Odor Control.—Many of the older plants, built years ago outside the residential sections, are now surrounded with homes, and during the summer months the odors given off present a problem which the citizens who reside near the plant do not permit the community officials to overlook. These odors are usually due to the formation of hydrogen sulphide during the decomposition taking place in septic tanks or in poorly operated plants of other types.

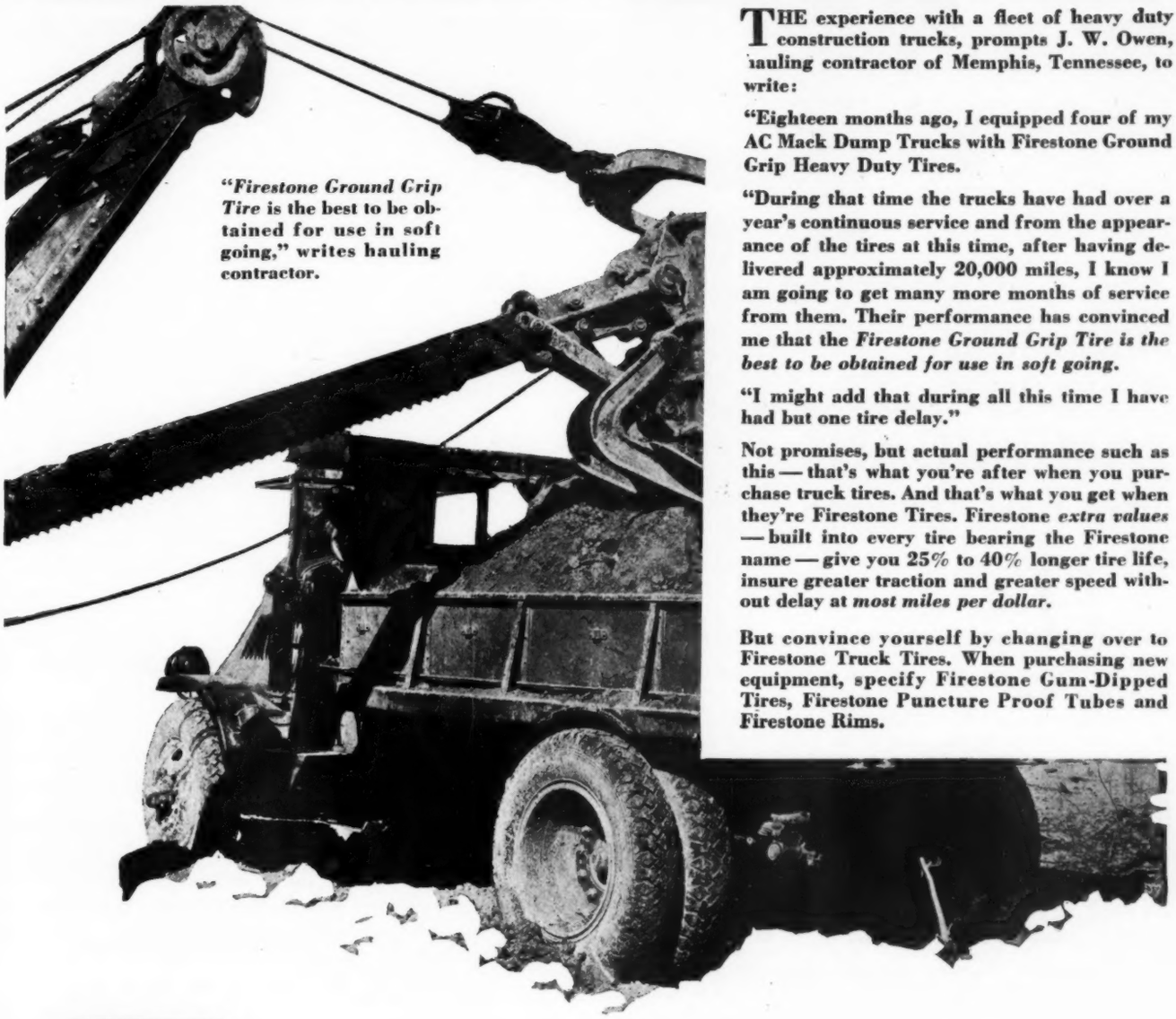
As a first step toward remedying this condition, the operation of the plant should be checked by a competent engineer. Proper operation may prevent the formation of offensive gases; or it may be found desirable to use chlorine, the function of which is to prevent the formation of the hydrogen sulphide or to neutralize it after formation. Such treatment does not interfere with the operation of the plant but generally eliminates the odors. (The method employed at a plant in Macon, Mo., was described in PUBLIC WORKS for October, 1929, page 400.)

Remodeling Old Plants.—In many communities there are old plants which, at a moderate cost, could be reconstructed to modern lines, perhaps doubling the original capacity of the plant with a relatively small expenditure. Modern equipment of the types shown in Figs. 3 and 4 is especially suited for such reconstruction work,.

Engineering Advice.—In reconstruction, even more than in original designing of a plant, a high quality of engineering advice is absolutely necessary if the community is to secure the maximum return from its investment. Disposal of wastes forms one of the

One Whole YEAR of CONTINUOUS SERVICE

only ONE tire delay!



"Firestone Ground Grip Tire is the best to be obtained for use in soft going," writes hauling contractor.

THE experience with a fleet of heavy duty construction trucks, prompts J. W. Owen, hauling contractor of Memphis, Tennessee, to write:

"Eighteen months ago, I equipped four of my AC Mack Dump Trucks with Firestone Ground Grip Heavy Duty Tires.

"During that time the trucks have had over a year's continuous service and from the appearance of the tires at this time, after having delivered approximately 20,000 miles, I know I am going to get many more months of service from them. Their performance has convinced me that the *Firestone Ground Grip Tire is the best to be obtained for use in soft going.*

"I might add that during all this time I have had but one tire delay."

Not promises, but actual performance such as this — that's what you're after when you purchase truck tires. And that's what you get when they're Firestone Tires. Firestone *extra values* — built into every tire bearing the Firestone name — give you 25% to 40% longer tire life, insure greater traction and greater speed without delay at *most miles per dollar.*

But convince yourself by changing over to Firestone Truck Tires. When purchasing new equipment, specify Firestone Gum-Dipped Tires, Firestone Puncture Proof Tubes and Firestone Rims.

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DEEP WELL TURBINES

HIGHER efficiencies than ever with a consequent low cost per gallon are obtainable with the new line of "American" Deep Well Turbines. Further refinements in design materially cut the cost of water supply.

The American Well Works engineers are largely responsible for the development of the Deep Well Turbine and have constantly led the way in reducing the cost of water to municipalities. The new "American" Turbines have all the features that have made "American" Deep Well Turbines standard equipment in municipal pumping stations.

These new turbines are designed for wells as small as 6" in diameter. The turbine head consists of a vertical motor mounted on a rigid and compact base, to which is attached the supporting pipe, to the lower end of which is connected the turbine proper.

"American" engineers and sales offices will gladly furnish data to municipal engineers or officials on this new, low pumping cost turbine.

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When writing, please mention PUBLIC WORKS

most vexing problems that city and village officials are called upon to handle; sewage treatment plants are not built frequently; and money for them is difficult to get. It is therefore of the highest importance that such moneys be expended in the wisest possible fashion, with intelligent foresight, whether the job be that of constructing a new plant, or of remodeling or improving the old one.

Costs

It is not possible to give any definite estimate of costs, because local conditions vary so widely. The cost may be two or three times as great where a high degree of treatment is necessary as where simple sedimentation is sufficient. Today construction costs are very low and the present time is the most favorable in years for such construction, both from the viewpoint of construction costs, and because the science of sewage treatment has arrived at a stage where a plant of a given size can be designed which will treat four or five times the volume of sewage that could be handled by designs of fifteen or twenty years ago, and treat it much better.

Operation

The necessity of proper operation to secure full return from the investment in the plant has been mentioned. It is also necessary, in many instances, to prevent suits against the city for creating a nuisance. There is no better legal defence against such action than a series of daily reports showing substantial compliance with State Board of Health requirements.

The time to provide for proper operation is when the finances for constructing the new plant, or for the reconstruction of the old plant, are being arranged. Such finances should provide as definitely for an annual sum adequate to properly operate the plant as for the payment for its construction. A community too poor to pay for proper operation is too poor to have a sewerage system.

Large Garbage Trucks Used in Jacksonville

(Continued from page 50)

"Our routes are carefully laid out and definite time schedules have been established so the garbage cans will not be left along the curb for too long a period before or after collection.

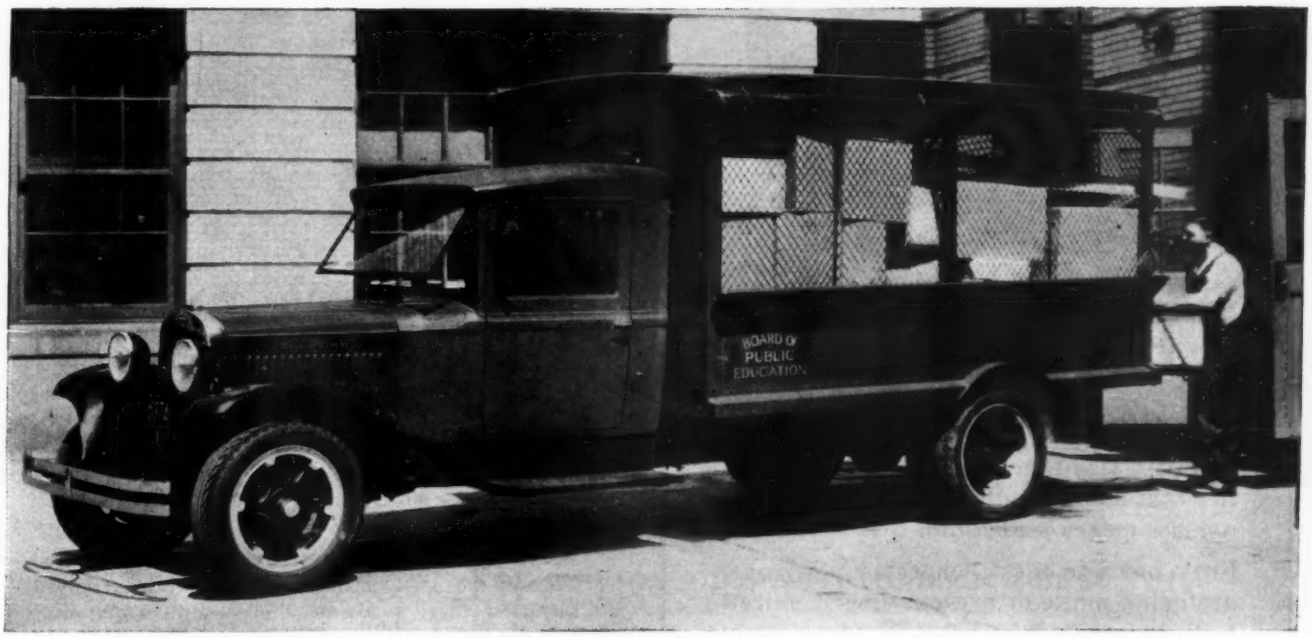
"All downtown streets and arterial highways are serviced at night to avoid heavy traffic. How many collections should be made each week is an important question. The warm, damp climate of Jacksonville makes daily collection (except Sunday) desirable. We accomplish this in all except sparsely settled suburbs.

"Like most other cities, we have been experimenting in garbage disposal methods. In 1917 we put in a modern odorless incinerator. Now we have five units with an average daily capacity of 260 tons."

Another interesting point made by the speaker was that the per capita cost of collection increased when the area of the city was increased. In 1925 the area was increased from 15.35 square miles of land area to 26.38 by the addition of many sparsely settled suburbs distant from the disposal plant; and the collection, which had cost $1.56, $1.57 and $1.60 the three years previous, jumped to $1.96, $1.86 and $1.95 the three years following.

Earning ability!

THAT'S THE FINAL TEST OF TRUCK VALUE



After all, the final test of a truck's value is its earning ability. Dodge trucks not only earn—they earn more, for several very definite reasons. » » In the Standard 1½-ton chassis, for instance, you get Dodge quality and design. Its price—only $595 f. o. b. Detroit—calls for but a small investment. Then, because of this truck's many exceptional features, you get greater dependability, ample power, ease of control, speed, safety, economy and long life—all an assurance of maximum earning ability. » » Inspect and test this 1½-ton truck or any of the many other types in the Dodge line. You will find that the experience gained in building over 400,000 quality Dodge Trucks assures you a truck that is precision-built and perfectly balanced part-to-part—a truck that will work and earn for you every mile of its long life.

PAYLOAD CAPACITIES IN THE HEAVY-DUTY LINE RANGE FROM 3,600 TO 11,175 POUNDS—AND UP, FOR TRACTOR AND TRAILER SERVICE. PRICES ARE EXCEPTIONALLY LOW. » » THE STANDARD LINE RANGES IN PAYLOAD CAPACITY FROM 1,200 TO 4,300 POUNDS AND INCLUDES THE 1½-TON CHASSIS AT . . . . . $595 F. O. B. DETROIT

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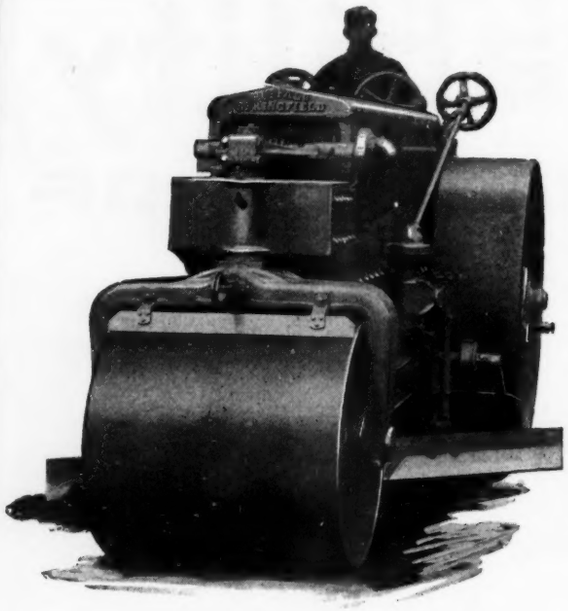

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Ability to lead means having those qualities that men recognize as superior. *Nothing else* makes leadership.

From coast to coast, wherever new roads are being made or present ones repaired, Buffalo-Springfield Road Rollers are the choice of the men on the job. Advanced design and superior performance make these rollers widely accepted as leaders worthy of the name.

Various steam and motor-driven designs in all practical sizes. Attachments when desired. *Interesting booklet on request.*

The Buffalo-Springfield Roller Co.
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BUFFALO—SPRINGFIELD ROAD ROLLERS

The Why and How of Water Purification

(Continued from page 16)

The rate of filtration is rapid—a bed 18 feet by 20 feet will filter about 1,000,000 gallons per day. Filter tanks are now quite generally made of concrete, iron or wooden circular tanks no longer being used to any extent except in very small installations. Equipment for regulating the rate of flow must be provided, as careful control of the process is necessary.

After the filter has been in operation for some time, it becomes clogged with dirt and must be cleaned. The length of run between cleanings depends, of course, upon the amount of dirt carried by the water. In a modern plant, cleaning of the filter beds is a comparatively easy job; the incoming water is shut off, and the flow through the filter is reversed, that is, the water is passed upward through the sand bed, but at a more rapid rate, washes out the dirt, and is discharged into a sewer. In some places compressed air is used to agitate the sand bed during washing, but in most plants the reversal of the flow is sufficient to remove the dirt. Under ordinary conditions, about 15 minutes are required for washing a filter.

When properly operated, the rapid sand type of filter, when preceded by coagulation, will remove about 99 per cent of the bacteria in the water and practically all of the turbidity and color. Even such heavily contaminated and unpleasant appearing water as that from the Missouri river can be made clear, safe and attractive by these processes of treatment.

Chlorination.—Despite the fact that 99 per cent or more of the bacteria in the water may be removed by filtration, there is always the possibility that the few bacteria surviving may cause disease. Therefore, in most modern water treatment plants, provision is made for treating the filtered water with chlorine to remove these few remaining bacteria. Liquid chlorine is generally employed for this, as being the cheapest, most modern and most satisfactory method. This liquid chlorine is applied by apparatus which allows very exact control of the amount of chlorine used. This is necessary, since the usual dosage of chlorine is only about 1½ pounds per million gallons of water. The cost of chlorination is very small and the process practically automatic.

Even when the water is clear, and filtration or other treatment is not required, chlorination should be employed as a safeguard against the chance contamination that may occur, whether in wells or on protected watersheds. There are so many opportunities for contamination of most supplies—leaky casings and poor covers in the case of wells, and pollution by hunters, picnickers and fishermen on water sheds—that such precaution is necessary if full and continuous protection against water-borne disease is to be assured.

Tastes and Odors—The causes of tastes and odors are numerous and the method of treatment varies to some extent with the cause. In some instances trade wastes from factories are the cause of tastes. Chlorination intensifies the tastes from wastes containing phenols and makes them more disagreeable. In such cases, the treatment of the water by means of carbon filters or by powdered activated carbon has been found

(Continued on page 72)

for that **TOUGH SPOT**

WILLIAMSPORT *Wire Rope*

Longer life and **ENDURING STRENGTH !**

You frequently run into heavy digging which tests the capacity of your machine, often taxing the capacity of your wire ropes. You may be miles away from the source of your supply. It is in these trying times you'll appreciate more the value of a good rope.

If you are accustomed to hard service, suppose you see what a Williamsport Rope will do for you.

And, too, if Williamsport performs so well in times of stress, you may expect a longer service from it in ordinary work.

Consult freely our engineers on your problems—they have rendered some valuable service to wire rope users—they may help you with their advice.

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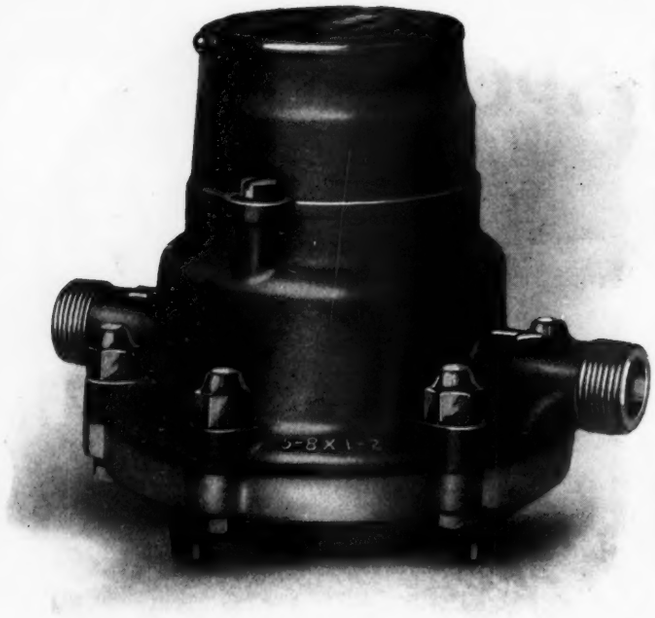

NIAGARA WATER METERS

Preferred by Smaller Waterworks

IN the smaller waterworks, facing the special problems of small town water supply, the Niagara is the preferred water meter. The reasons for this preference are important.

Niagara Meters are so durable in service, so correct in design, that many meters installed 35 to 38 years ago are still in continuous operation. This long life is of the utmost importance, for during all these years, the meter must earn revenue amounting to hundreds of dollars, registering accurately at all rates of flow.

Niagara Meters are especially designed for the hard water found in most small towns. They are hot-zinc-dipped, inside and out, preventing corrosion. The gear train is the patented chromium-shell type, wearproof, corrosionproof and sanitary.

Design is the simplest of any meter, making replacements negligible, and repairs unusually easy. Repair parts are always quickly obtainable at low prices.

Niagara Water Meters are made in all models and sizes, from 5/8" x 1/2" to 6". Small towns that order but a few at a time, can purchase economically at low prices. Write for catalog and liberal discounts. No order is too small.

BUFFALO METER COMPANY
2920 Main Street Buffalo, N. Y.

NIAGARA (IRON CASE) and AMERICAN (BRONZE CASE) Water Meters

When writing, please mention PUBLIC WORKS

The Water Wheel

(Continued from page 49)

drinking contaminated water should be compensated under the workman's compensation act[n109]. It was held that the death was due to **accident.**

Much interest has been shown in medical and bacteriological circles over the work of Arthur I. Kendall, who claims that he is able to produce **bacterial organisms in filterable and non-filterable states.** He believes that most organisms—including the typhoid organisms—can exist in these two states. If the work he has done is confirmed, it may have far-reaching results in modifying attempts at water purification[79]. Alice Evans[76] has isolated a new subspecies of the organism, **Alkaligenes faecalis,** from the blood of a student nurse in Baltimore, sick with a typhoid-like fever. The organism was apparently pathogenic to guinea pigs soon after isolation, but rapidly lost its pathogenic character.

A valuable summary of the assistance which the **purification laboratory** can render to the water industry has been compiled by Flentje and Wilson[62].

Various

The Drought.

New summaries on the effect of the drought in **Pennsylvania**[114], in **Charleston, W. Va.**[113], in **Baltimore**[13], in **New England**[66] and in **Rockport, Massachusetts**[67], have appeared.

Sanitary Drinking Fountains.

The standards of the American Public Health Association for sanitary drinking fountains have been republished in the Canadian Engineer[n8]. The Women's Bureau of the U. S. Department of Labor has issued a valuable bulletin[7] which summarizes the work on **drinking fountains** in very complete form.

Swimming Pools.

Stevens[24] describes a private pool of elaborate construction at Milwaukee as an "ideal swimming pool." Two other articles consider the capacities of swimming pools in terms of bathers accommodated[14, n111]. It is said that the state of New Jersey is to sue the state of New York for **beach pollution** damages in the effort to force emergency measures for improved garbage disposal[n30].

Trout Pool.

A new public amusement feature has appeared in Denver in the form of a **trout pool.** Special pools of concrete with aeration, forced current and artificial cooling, contain numbers of trout which patrons may catch with lines and bait furnished by the management. The city system is the source of the water in the pools[26].

Bibliography of Recent Water Works Literature

* The Three Leading Articles.
n Note or Short Article.

The American City, Vol. 45, No. 2 (August, 1931.)
n1. Operating Expenses of the La Crosse, Wisc., Water Works, Frank J. Dockendorf, page 7.
n2. 90-Year-Old Cast Iron Pipe Unearthed in New York, Patrick Quilty, page 7.
3. Determining Population in Off-Census Years, H. C. Brown, Jr., pp. 95-96.
4. Troublesome Iron Removed from a New Water Supply, W. B. Rollins, pp. 96-97.
5. Water Rates and Regulations, Part IV, pp. 124-125.

American Journal of Public Health, Vol. 21, No. 8 (August, 1931.)
6. A Mechanical Aid for Isolating B. Coli, E. L. Filby, pp. 940-941.

Bulletin Women's Bureau, U. S. Department of Labor, Bull. 87, 1931.
7. Sanitary Drinking Facilities, with Special Reference to Drinking Fountains, Marie Correll, pp. vi plus 26. (Supt. of Documents, Washington, 10c.)

Canadian Engineer, Vol 61, No. 1 (July 7, 1931.)
n8. Design of Sanitary Drinking Fountains, Anon., p. 21.
n9. Bacterial Examination of Water (omitted portion of Norman J. Howard's paper in June 30th issue), p. 54.
n10. High Water Consumption at Windsor, Anon., p. 58.

What's 90 years to a Cast Iron Pipe!

A CONSTRUCTION crew of the Board of Water Supply of New York City were cutting out a piece of a 90-year-old water main to install a new valve. Representatives of the engineering press and Water Department officials watched them pounding away at that sturdy old pipe with chisels and sledges. Tough! Before it was cut through, diamond points and cold chisels were splintered and frayed as though they were tin.

On inspection, the removed length of pipe proved to be in excellent condition, indicating that this 90-year-old cast iron main will continue to serve New York's taxpayers, and save them money, for many years to come.

✣ ✣ ✣

How long *is* the life of cast iron pipe? For cost computing purposes, engineers rate the minimum useful life of cast iron pipe at 100 years, far beyond that of any other material. A writer in the May issue of the Journal of the American Water Works Association answers the question for himself by saying "Five hundred years or more."

In France, a cast iron pipe line from Marly on the Seine River to Versailles (about six miles) has been in continuous service for 267 years. In America, cast iron water and gas mains that were installed over a century ago are still giving satisfactory service.

Representatives of engineering publications and American Water Works Association assembled at East Broadway and Montgomery Street, New York City, to inspect section of 90-year-old cast iron pipe removed to cut in a valve. The pipe was exceedingly tough and in excellent condition.

CAST Q IRON

Look for the "Q-check" symbol as shown above. It is the registered trademark of The Cast Iron Pipe Research Association.

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The reason for the long life of cast iron pipe is its effective resistance to rust. Cast iron is the one ferrous metal for water and gas mains, and for sewer construction, that will not disintegrate from rust. This characteristic makes cast iron pipe the most practicable for underground mains since rust will not destroy it.

Every taxpayer should take an active interest in the kind of pipe being laid, or to be laid, in his community. For further information write to The Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, 122 South Michigan Avenue, Chicago, Ill.

✣ ✣ ✣

Cast iron pipe bearing the "Q-check" trademark is obtainable from the following leading pipe founders: Alabama Pipe Company, Anniston, Ala.; American Cast Iron Pipe Company, Birmingham, Ala.; James B. Clow & Sons, 219 N. Talman Ave., Chicago, Ill.; Donaldson Iron Company, Emaus, Pa.; Glamorgan Pipe and Foundry Company, Lynchburg, Va.; Lynchburg Foundry Company, Lynchburg, Va.; National Cast Iron Pipe Company, Birmingham, Ala.; United States Pipe and Foundry Company, Burlington, N. J.; Warren Foundry and Pipe Corporation, 11 Broadway, New York.

CAST IRON PIPE

The above page advertisement of The Cast Iron Pipe Research Association will appear in Time, *September, 21st*—Collier's, *October 24th*—Saturday Evening Post, *October 31st*

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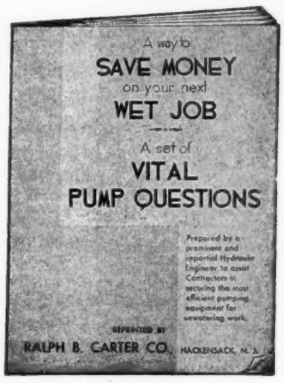

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11. Machine Billing for Water Works, A. B. Manson, pp. 65-66.

Canadian Engineer, Vol. 61, No. 2 (July 14, 1931.)
n12. Huge Water Supply for New York, Anon., pp. 51-52.
13. Drought Effect on Water Supply, James W. Armstrong, pp. 515-516.

Canadian Engineer, Vol. 61, No. 3 (July 21, 1931.)
14. Swimming Pool Design Features, W. A. Becker, p. 20.
15. Aerial Mapping for Water Studies, James W. Armstrong, p. 21.
n16. Production of Lime in Canada, Anon., p. 50.
17. Corrosion of Iron and Steel, Anon., p. 53.

Canadian Engineer, Vol. 61, No. 4 (July 28, 1931.)
18. Operation of Rapid Sand Filters, A. H. Ulrich, p. 54.
19. Eliminating Water Works Losses, Frank C. Jordan, pp. 19-20, 49-50.

Civil Engineering, Vol. 1, No. 11 (August, 1931.)
20. New Water Laws in the Making, W. L. Stevenson and Charles E. Ryder, pp. 991-996.
21. A Conservative Design [for Hoover Dam], Elwood Mead, pp. 1001-1002.
22. Safety of Hoover Dam, H. M. Westergaard, pp. 1003-1004.
23. Earth as a Basic Material of Construction, Charles H. Lee, pp. 1015-1020.

Domestic Engineering, Vol. 136, No. 2 (July 25, 1931.)
24. An Ideal Swimming Pool, William W. Stevens, pp. 30-35.
25. Friction in Tees Exhibits Curious Variation, F. E. Giesecke and W. H. Badgett, pp. 43-45 and 128.
26. Denver Tries Fishing from an Easy Chair, Anon., pp. 64, 67-68.

Engineering News-Record, Vol. 107, No. 2 (July 9, 1931.)
27. Ventilation during Driving of New York's 20-Mile Water Tunnel, C. F. Kelley and I. R. Ross, pp. 58-59.
28. Concrete Lining for Irrigation Canals in Texas, A. J. Moore, pp. 60-61.
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n30. New Jersey to Sue New York for Beach Pollution Damages, p. 73.
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Engineering News-Record, Vol. 107, No. 3 (July 16, 1931.)
n32. Experimental Filter Tubes [a Letter], Roberts Hulbert and Douglas Feben, p. 109.
n33. A Proper Balance for Water Works Papers [a Letter], Harry E. Jordan, p. 110.
n34. Work on Eleven Mile Canyon Dam Year Ahead of Schedule, p. 114.
n35. Reinforced Concrete Cover for Two Reservoirs, p. 119.

Engineering News-Record, Vol. 107, No. 4 (July 23, 1931.)
n36. Pipe Line Corrosion and Soil Conductivity, p. 135.
n37. Lachine, Quebec, to have 6,600,000 Gallon Filtration Plant, p. 153.
n38. Elizabeth, N. J., Acquires Water Distribution System, p. 155.

Engineering News-Record, Vol. 107, No. 5 (July 30, 1931.)
39. Madden Reservoir to Increase Water Supply of Panama Canal, pp. 162-164.
40. Composition of Earth Dams, Part III, pp. 168-172.
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45. Steel Pipe for Cleveland, p. 197.

Le Genie Civil, Vol. 99, No. 1 (July 4, 1931.)
46. Mode d' Ecoulement des Eaux des Nappes Souterraines, E. Maynard, pp. 7-9.

Gesundheits Ingenieur, Vol. 54, No. 38 (July 11, 1931.)
47. Einige Eigenschaften des Wassers in neuer Betrachtung, A. Reuther, pp. 436-439.

Gesundheits Ingenieur, Vol. 54, No. 29 (July 18, 1931.)
48. Unter welchen Umständen wirken feinporige wasserdurchlässige Boden grunduasserbildend? Chr. Mezger, pp. 445-449.

Heating, Piping and Air Conditioning, Vol. 3, No. 8 (Aug., 1931.)
49. Piping a Pumping Station, Orville B. Carlisle and Duane E. Kennedy, pp. 642-648.

Journal of the American Water Works Association, Vol. 23, No. 7 (July, 1931.)
*50. Use of Water in Arid and Semi-Arid Cities, N. T. Veatch, Jr., pp. 937-954.
51. Equitable Charges for Sprinkler Fire Protection, L. R. Howson, pp. 955-959.
52. Solution of the Dual Flow Problem by Graphical Analysis, Grant K. Palsgrove, pp. 960-967.
53. Two Failures of Welds on Small Patches in Large Steel Pipe, W. W. Brush, pp. 968-973.
54. Copper and Brass Pipes and Tubes, William G. Schneider, pp. 974-992.
55. Century Old Cast Iron Water Main, Seth M. Van Loan, pp. 993-994.
56. Some Problems of Water Well Capacities, Howard O. Williams, pp. 995-1009.
57. Water Softening at Bloomington, Illinois, Charles H. Spaulding, pp. 1010-1013.
58. An Artificial Subterranean Water Supply System, Leland W. Parr, pp. 1014-1016.
59. Report of the Committee on Water Works Practice, Malcolm Pirnie, et al., pp. 1017-1033.
60. Boca Raton Water Treatment Plant, H. S. R. McCurdy, pp. 1034-1040.
61. South Dakota Water Supplies, W. W. Towne, pp. 1041-1046.
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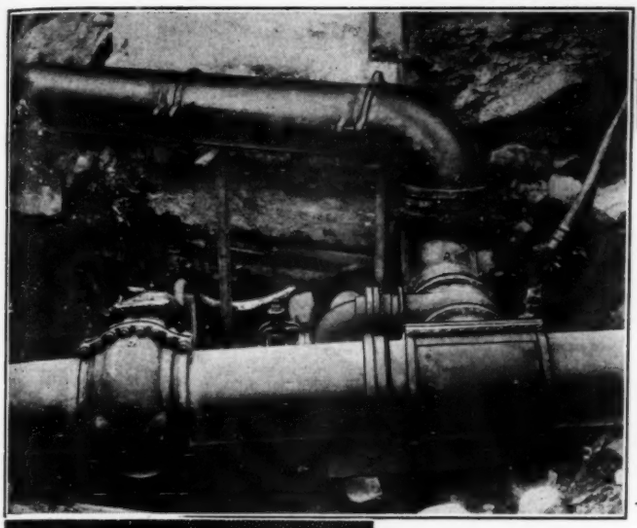
63. Typhoid Fever in the Large Cities of the United States, pp. 1059-1071.

Journal of the New England Water Works Association, Vol. 45, No. 2 (June, 1931.)



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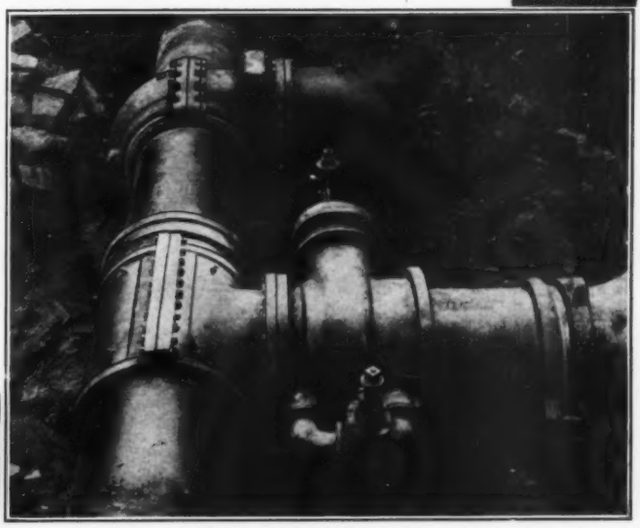
ILLUSTRATIONS

Above: 30" Valve Insertion at left; 24" x 30" Tap at Right

Below: 30" Valve Insertion Above, 24" x 30" Tap Below



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64. The New Gravity Water Supply System of Albany, N. Y., Robert E. Horton and Benjamin L. Smith, pp. 89-135.
65. Recent Developments in Chlorination, Francis D. West, pp. 136-144.
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70. Items in the Operation of New York City's Water Supply System of Interest to the Superintendent, W. W. Brush, pp. 181-187.
71. Wrought Iron, James Ashton, p. 188.

Power, Vol. 74, No. 3 (July 21, 1931.)
72. Corrosion: What It Is. W. S. Johnston, pp. 87-89.

Power, Vol. 74, No. 5 (August 4, 1931.)
73. Corrosion Prevention by Protective Coatings, W. S. Johnston, pp. 155-157.

Proceedings of the Iowa Academy of Science, Vol. 33 (1930.)
74. Purification of Water by Electro-Osmose, Edward Bartow and R. H. Jebens, pp. 211-216.
75. Maximum Precipitation in Short Periods of Time, Charles D. Reed, pp. 263-265.

Public Health Reports, Vol. 46, No. 29 (July 17, 931.)
76. A New Subspecies, Radicans, of Alcaligenes faecalis, Alice C. Evans, pp. 1676-1680.

Quarterly Bulletin West Virginia State Department of Health, Vol. 18, No. 3 July, 1931.)
77. Public Water Supplies of West Virginia, E. S. Tisdale, pp. 3-35.

Railway Engineering and Maintenance, Vol. 27, No. 8 (August, 1931.)
78. Zeolite Plants Effect Economies, Anon., p. 715.

Science, Vol. 74, No. 1910 (August 7, 1931.)
*79. Observations upon the Filterability of Bacteria, Including a Filterable Organism Obtained from Cases of Influenza, Arthur I. Kendall, pp. 129-139.

The Surveyor, Vol. 80, No. 2058 (July 3, 1931.)
80. Modern Aspects of Water Purification, E. Sherman Chase, pp. 3-4.
81. Modern Dam Construction, Caleb Mills Saville, pp. 5-6.

The Surveyor, Vol. 80, No. 2059 (July 10, 1931.)
82. The Sinking of Boreholes, H. A. P. Hetherington, pp. 45-46.

The Surveyor, Vol. 80, No. 2060 (July 17, 1931.)
83. The Construction of Modern Water Mains, F. W. Macaulay, p. 47.

Water Works Engineering, Vol. 84, No. 14 (July 15, 1931.)
84. Tastes and Odors in Small Water Supply Removed by Ammonia, J. E. Lyles, pp. 1003-1004 and 1045.
85. Personal Service Rating Methods, Joseph F. Majeske, pp. 1005-1006 and 1045.
86. The Control of Sewage and Industrial Wastes in the Purification of Rivers and Streams, John M. Henderson, pp. 1007-1008, 1041-1042.
87. An Analysis of the Characteristics of Filter Sand, James W. Armstrong, pp. 1009-1010, 1026, 1029-1030.
88. Effects of a Canalized River on a City Well Water Supply, John H. Burwell, Jr., pp. 1014, 1033-1034.
n89. Unusual Method for Purchase of Water Department Pumps, J. M. Lowman, p. 1016.
90. Solving Dual Flow Problems by Graphical Analysis, Grant K. Palsgrove, pp. 1022 and 1025.

Water Works Engineering, Vol. 84, No. 15 (July 29, 1931.)
91. Methods of Prospect Drilling for City-Owned Water Supplies, Howard E. Simpson, pp. 1071-1072 and 1106.
*92. Theory and Application of the Sand Expansion Index in Filter Washing, Part I. Theory. Roberts Hulbert, pp. 1073-1074, 1097-1098 and 1101.
93. The Riparian Law vs. the Appropriative Doctrine in Allocation of Streams, Harold Conkling, pp. 1075-1076, 1101-1102 and 1105.
94. Present Status of Taste and Odor Removal from Water. Paul Hansen, pp. 1077-1078 and 1094.
n94. The Flow Powergraph, A. T. Clark, p. 1082.
n96. Ninety Years Old Pipe Good for Another 100 Years of Service, Anon., p. 1084.
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n102. City Permits Men to Work out Bills, p. 1089.
103. Difficulties Encountered at a Small Filter Plant, T. A. Stout, pp. 1089-1090.
104. Water Softening Experiences at Bloomington, Illinois, Plant. Charles H. Spaulding, pp. 1090 and 1093.

Water Works and Sewerage, Vol. 78, No. 7 (July, 1931.)
105. Correcting for Errors Caused by Manganese in the Residual Chlorine Test, Linn H. Enslow, pp. 183-184.
n106. Results of Plankton Studies in Illinois River, p. 188.
107. How Payment Is Secured for Water Used in Construction Work, Symposium, pp. 189-190.
108. Corrosion Reduction with Lime Treatment, Edward S. Hopkins, pp. 191-2.
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114. Effect on Water Supply of 1930 Drought in Pennsylvania, Howard E. Moses, pp. 202-204.
n115. Twenty-Four Companies Purchased by Delaware Concern, p. 209.

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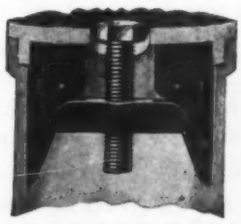

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(Continued from page 24)

the tax duplicate and will facilitate the preparation of a delinquent tax duplicate. Further, by adding the penalty, they may be used for the second half of the current year's tax installment.

Under manual operation, the former procedure in the auditor's office required seventy-two men, and even then the tax bills could not be completed by the date required. The mechanical installation, providing for only two classes of devices, is of such a nature that the same personnel operating the addressograph division is being trained to operate the tabulating machine division, thus giving flexibility to a personnel to provide for year-round employment of only fourteen employees doing the work which formerly required seventy-two. Then, too, these fourteen employees in the auditor's office will be available for the treasurer's office during the tax collection period.

It is conservatively estimated that this installation in the auditor's and treasurer's offices will save Hamilton County approximately $75,000 the first year, and more than $125,000 each succeeding year. Not only is the system economical, but it makes possible the mailing of tax bills so that taxpayers will receive them on the first day of the tax collection period. An additional feature of the equipment is that it fits in with a contemplated installation in Hamilton County of a centralized accounting system such as is now in operation in the office of the city auditor. Under the new system the tax bills will be neat and accurate, the property description thoroughly comprehensive, and the plan in the final analysis presents a simple, rapid, and economical method of procedure.

The above is an abstract of a paper read before the convention of the International Association of Comptrollers and Accounting Officers at Toronto in June, 1931.

Boulder City, to House the Builders of Hoover Dam

(Continued from page 27)

belongs to the abutting owners but must be kept by them according to the planting arrangement of the group. A narrow road of semi-public character ties the homes to the main street. The advantages of this system are that no home fronts on a traffic artery. All homes front on a small open space; all homes are close to a good traffic street without suffering from it. In the interior of the area all the groups connect with a central playground, which is absolutely safe, close to all homes, and attractive. The per family cost for street construction in this type of residential development is less than in the usual type of gridiron blocks. Every home has a good setting and the treatment can be elaborated for larger homes and made smaller for small homes.

11. On the plan the second girdle of the city is formed by the airport and a golf course. The city is not expected to grow beyond this but plans for extension are indicated.

12. Commercial hotels front on the civic park; a tourist hotel is located on a knoll adjoining the city.

13. Churches are all grouped in one section of the city to stimulate religious consciousness.

14. Use is made of every public building to create

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Field windings on the new machine are so placed as to increase its efficiency. There are ball bearings on the armature shaft; and a thrust bearing for the rack bar in the direct line of the thrust instead of offset as formerly.

The new machine has a rated capacity of 100 electric blasting caps. As a matter of fact, it has often fired as many as 125 holes connected in series. The weight of this machine is a little less than 36 pounds.

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15. A grade school and a high school will front on the forest belt. Both are located away from traffic lines and are given an attractive setting. An athletic field adjoins the high school.

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Sewage treatment will be by the separate sludge digestion process.

House Numbering Reform in Milwaukee

(Continued from page 26)

to be "absolutely rust-proof," and the surface characteristics not to "materially change to detract from the appearance or lessen the visibility for a period of at least ten years." The materials not be "unduly fragile" or "too brittle or frail for handling and assembling and installing in the field when handled with reasonable care."

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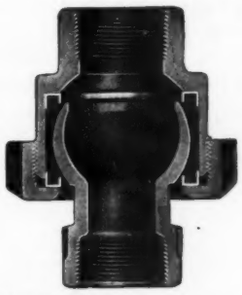
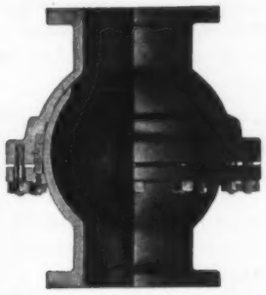


Flexible Joints screw end
¼" to 6"

Swivel Joints screw end
½" to 1¼"



Flexible Joints flange end
4" to 48"

Barco Joints are made in sizes from ¼" to 3" inclusive, of malleable iron; from ¼" to 2" inclusive, of bronze, from 4" to 48" inclusive, of Semi-Steel.

Barco Standard Joints are suitable for 200 lb. steam pressure per sq. in., up to and including the 3" size whether made of bronze or malleable iron. The standard Semi-Steel joints 4", 5" and 6" are constructed for 125 lb. steam pressure.

Barco Joints of all sizes can be made of special materials for special purpose such as to resist acids. They are also made extra heavy for high pressures.

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The Why and How of Water Purification

(Continued from page 60)

to be highly successful. In many cases the use of a small amount of ammonia with the chlorine will eliminate taste troubles. Chlorination should never be discontinued because of tastes intensified by it, since the presence of the wastes causing tastes is evidence that contamination can occur and is occurring, but ammonia or carbon may be employed to correct the trouble.

Tastes may also be caused by algae growths in the water during the warmer months of the year. By periodic treatment with a small amount of copper sulfate, beginning early in the season, such growths may generally be prevented; but if they do occur, the purification methods already outlined, or aeration, may be used.

Aeration consists in spraying the water into the air, or in allowing it to flow in thin sheets over weirs. This allows gases dissolved in the water to escape into the atmosphere, and the oxygen in the atmosphere combines with impurities in the water which cause tastes and odors, so as to reduce materially or eliminate them entirely. Coagulation and filtration also reduce many odors, but cannot be relied upon to eliminate those caused by phenol compounds.

Tastes and odors may also occur in water which has its source in swamp lands. Aeration is usually especially effective in eliminating troubles due to this source.

The first step toward the procurement of a purification plant or the modernizing of a plant is to employ a first class, high-type consulting engineer, who should be empowered to investigate the entire problem of water supply. In most communities the construction or modernizing of a purification plant will necessitate a bond issue.

Old Philadelphia cast iron pipe.

Therefore, when the engineer has rendered his report, an educational campaign should be started to familiarize the citizens with the many advantages that will accrue from the improvements proposed. Such a campaign should not be based on high-pressure methods, but should aim to convince the citizens of the many benefits that will be derived, including better health and increased property values from a more satisfactory water. If the plan involves additional water supply, there may be a financial return from lowered fire insurance premiums. A community in New York state last year spent $25,000 on a water supply system, and saved enough in reduced insurance cost to pay the total interest and sinking fund charges on its system. All these and any other advantages should be explained fully so that the bond issue may not be voted down because of the failure of voters to understand the advantages to them, individually and as a community, of the proposed works.

Oldest Cast-Iron Pipe in the United States

In 1817 Philadelphia imported a small amount of cast-iron pipe from England, which was laid as an experiment as part of its distribution system. Up to this time no cast-iron, but only wood pipe, had been laid in this country. Following this the use of cast-iron pipe became increasingly common.

This Philadelphia pipe was bell and spigot type, in 9-foot lengths, each having three or four rings about it approximately 1½ inches wide, presumably to afford thicker places into which to insert taps. (The photograph indicates that the taps have not always been placed at these thicker points.)

On April 30th a piece of this old pipe was removed. The photograph shows this piece in the trench before removal. It was found to be in excellent condition after more than a century of use, and good for many years to come if it were large enough for the future needs of the district.

While this is believed to be the oldest cast-iron pipe in this country, there are much older ones in Europe, possibly the oldest still in service being those from the reservoirs of Picardie to Montbaron, in France, now 267 years old.

Street Improvements in a Small City

(Continued from page 18)

is improved, it should be improved from curb to curb; and in most cases so little would be saved, if anything, by using a cheaper type along the gutter parking space than in the center, and the appearance would be so much better if the same kind of improvement be used throughout, that the latter is the better plan.

Business and Main Traffic Streets

The business section of a village generally is confined to one or two blocks on the main street, and in some cases another at right angles to it. As the village grows, the business occupies more and more length of this street, and creeps into the cross streets to an extent often determined by the topography or the conditions of traffic communication with the surrounding country.

As the area of the village increases, the main street ceases to be the only main thoroughfare, but others

(Continued on page 74)

Do you need more money to keep your CITY CLEAN?

Left: Ideal, double duty wagon for wet or dry garbage.

Below: 2 or 4 wheel, two horse, sanitary wagon for wet garbage.

SUPPOSE you had ONE wagon that would do the work which now requires THREE. What a difference that would make. It would not only save the city money, but would actually pay for itself in a very short time. We have designed just that kind of a wagon. It is an advanced type, low-hung, large capacity, easy dumping vehicle. It should not be confused with the ordinary yard and a half wagon used by many cities.

For the sanitary collection of garbage and refuse at low cost, the small city, especially, will find that HOLZBOG wagons have no equals.

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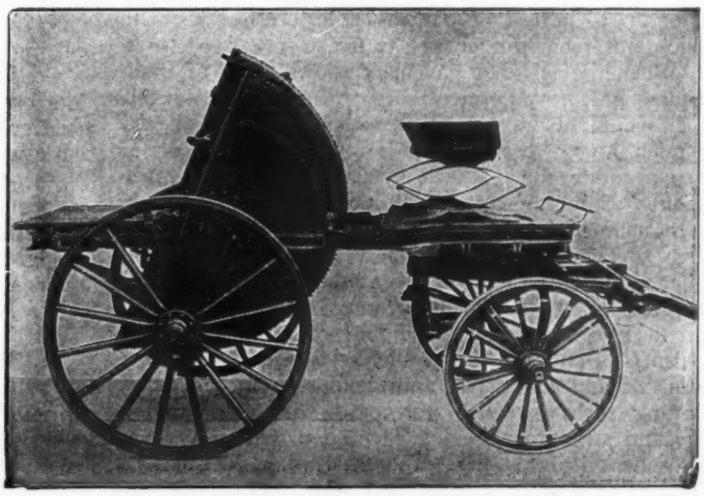

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How Wide on Curves?

(Continued from page 41)

Curves	0.1 P.C.—40	0.2 P.C.—30	0.3 P.C.—20	0.4 P.C.—10	0.5 P.C.	0.6 P.C.+10	0.7 P.C.+20	0.8 P.C.+30	0.9 P.C.+40	1.0 P.C.+50	P.C.+100	P.C.+150
6° to 10°	0	0	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0	2.0	2.0
11° to 15°	0	0.1	0.2	0.3	0.5	0.6	0.9	1.1	1.4	1.7	2.8	3.0
16° to 20°	0	0.1	0.2	0.4	0.6	0.8	1.1	1.5	1.8	2.1	3.0	3.0
21° to 25°	0	0.1	0.3	0.4	0.7	1.0	1.3	1.7	2.1	2.4	3.0	3.0
26° to 30°	0	0.1	0.3	0.6	0.8	1.2	1.6	2.1	2.6	3.0	4.0	4.0
31° to 35°	0	0.2	0.3	0.6	0.9	1.3	1.8	2.3	2.8	3.1	4.0	4.0
36° to 40°	0	0.2	0.4	0.7	1.0	1.4	1.9	2.4	2.9	3.2	4.0	4.0
41° to 45°	0	0.2	0.4	0.7	1.1	1.5	2.0	2.5	3.0	3.3	4.0	4.0
46° to 50°	0.1	0.2	0.5	0.9	1.3	1.8	2.5	3.2	3.7	4.1	5.0	5.0

Widening on Blackfeet Highway

Widening is added to the inside of the curve. The amount of widening is given in the accompanying table. (The table gives the superelevation also, which is omitted.)

For widening on a reverse curve, use the table just as if the curve were running off of a tangent; in other words, start the widening 50 feet back on each curve from the P. R. C. This will give a very small amount of widening on the outside of each curve for 50 feet on each side of the P. R. C.

On a compound curve the full widening for each curve is held to within 50 feet from the P. C. C. Starting with a point 50 feet from the P. C. C. on the curve with the lesser degree of curvature, the widening is increased by an amount equal to the difference in the widening found in the table for each curve at that point, multiplied by the number (such as 0.1, 0.2, etc.) found in the top lines of the column, taking the stationing of the point for this purpose in relation to the curve with the greater degree of curvature. The point 50 feet from the P. C. C. on the flatter curve corresponds to the column headed 0.0 and the one 50 feet from the P. C. C. on the sharper curve to the column headed 1.0.

at right angles to it develop as such, and still others paralleling it. The frequency and location of these are determined largely by the topography and traffic conditions, aided by wise street planning. (If such planning is not wise, traffic will refuse to be controlled by it.)

At first the kind of pavement suggested for residence streets may suffice for the business section and main streets, but the width of pavement is generally greater, to permit of parking along both sides with abundant room for moving traffic.

When the low-cost pavement shows signs of inadequacy to carry the increasing traffic, a more durable one should at once be laid to replace it, and be extended along this and other main traffic streets as the need develops. Such durable pavement is commonly of more substantial structure, with probably a permanent base calculated to outlast several wearing surfaces. It is extremely desirable, therefore, that attention be paid to the grade, width, crown and alignment of the roadway, any changes desirable in these being made at the time of the new paving. Also cuts and repairs in such a pavement are more difficult and expensive, and should be minimized by laying such sewers, water mains and other underground structures as may be needed, before the new pavement is laid—preferably at least a year before. Drainage should be provided, with storm water inlets at each corner so that it is not necessary to carry gutters across the intersecting streets. Now is the time also to relocate fire hydrants and wire-carrying posts (reducing the number of these, if possible, or eliminating them by burying the wires, or relegating them to less important streets or lines through the centers of the blocks), placing them as near the curb as possible without being so near as to be struck by the hubs of wheels.

There are two general types of heavy-traffic pavements—those in which the base is entirely separate from the wearing surface, and those in which the two are combined. Of the former, the common types are sheet asphalt, brick and stone block, laid on a base of portland cement concrete or bituminous concrete. The second class includes portland cement concrete without a supplementary wearing surface, and bituminous concrete; the latter including a variety of mixtures differing more or less from each other in kind or proportioning of ingredients, or in manner of mixing or laying—Topeka mix, Bitulithic, Amiesite, etc. Rock asphalt also might be included under this head.

The second class is generally cheaper than the first, and while not so durable under really heavy traffic, and costing more to replace (only the wearing surface of the first class needs to be replaced), will wear for many years under the medium heavy traffic of a small city if properly laid and not abused by too much cutting into with improper repairing of cuts.

Considerably more than half—probably three-fourths—of the heavy-traffic pavements laid in the smaller cities during the past five years have been of the second class—portland cement and bituminous concrete; and the percentage of these to the pavements of the first class has been increasing. This change is probably partly the cause and partly the effect of the great improvements that have been made in the science and art of laying such pavements.

Maintenance

A street pavement can not be laid and then forgotten. It is like an automobile in that, if not properly looked after, it will not give good service for long; and the most important periods of its life are the first few months and the last few. When new, it should be watched for evidence of weak spots in the foundation or local defects in construction, and these should be repaired at once, before the effect spreads. Cuts will be necessary now and then, no matter what pains are taken to avoid them, and the backfilling and repairing of these are of the greatest importance, requiring even more care and skill than the original laying.

As old age approaches and incipient disintegration develops in spots, if these are "doctored up" carefully the time when entire replacement of the pavement is necessary may be postponed several years. Few pavements are like the "one-hoss shay" and go to pieces all at once, but they undergo progressive deterioration, and it becomes a nice question for the combined judgment of the engineer and the taxpayers just when a comparison of the cost of a new pavement with that of patching the old, and of the appearance and riding quality of the two, warrants complete reconstruction.

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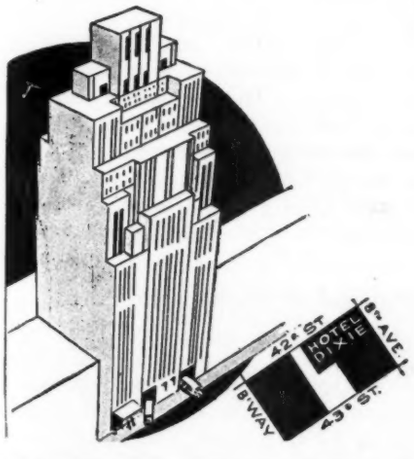

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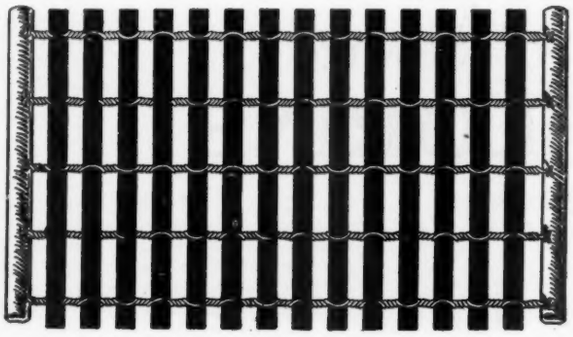

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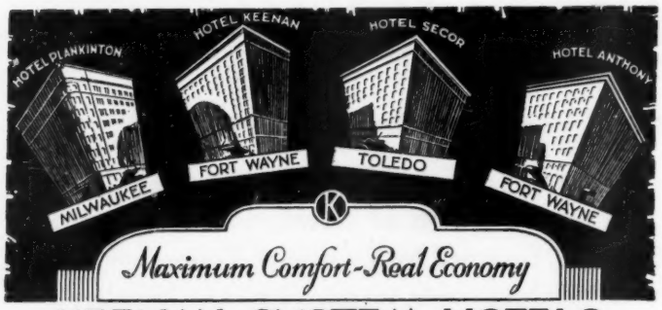

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laboratory facilities are readily available. Otherwise, samples may be taken at much less frequent intervals.

If examinations are made by the State Health Department laboratory—which is the best place when no city laboratory is maintained—monthly samples are sufficient in the case of a water plant securing its supply from a safe source and regularly receiving favorable reports from analyses of it. Where the source is questionable in character, weekly samples are better. If a new, or emergency, supply is adopted, frequent thorough examinations should be made.

Many states require samples every three months. This is better than no samples, but more frequent examinations are very desirable. The reports on examinations form a valuable record of the performance of the plant, and may be of very real worth in case of an epidemic or a suit for damages by a consumer who claims that pollution of the supply caused illness.

A Summer Camp for Engineers

SUMMER camps for Boy Scouts, Campfire Girls, and children of all ages, and surveying camps for engineering students, combining out-of-doors life and instruction, have become commonplace; but such a camp for graduate engineers is, we believe, a novelty. The Columbia Engineering Schools Alumni is co-operating with the Alumni Association of Stevens Institute of Technology in conducting an adult educational camp this summer at the Stevens Engineering Camp, in New Jersey a few miles from Delaware Water Gap.

At this camp, from August 29th to September 7th, the mornings will be devoted to lectures on Corporation Finance by Ralph H. Richards, William D. Ennis and George W. Barnwell, and the evenings to round table discussions of the Business Cycle and the present depression. In setting forth the purpose of the camp, James Creese, vice-president of Stevens Institute says: "The engineer in the complexities of his profession is constantly faced by economic problems, and as a citizen and as an investor he needs to know how to think in economic terms. However extensive his technical knowledge may be, he must learn to command economic technique also if he is to progress in executive responsibility in his own career, or to exercise in the community the influence which, from many points of view, he is unusually qualified to exert for the welfare of all."

Those attending will live in cabins housing either four or eight each. Afternoons will be free for golf, baseball, swimming, hiking, etc. Graduates of any engineering school and members of the engineering societies are eligible. The fee, which includes housing and good food, is $5 a day; less than the cost of operating the camp, the balance being contributed by the Carnegie Corporation. Further information can be obtained from James Creese, Vice-President, Stevens Institute of Technology, Hoboken, N. J.

Disposal of Garbage in Toledo

During 1930, 43,053 tons of garbage were collected in Toledo, Ohio, at a cost of $153,531.71, or about $3.57 per ton. All of this garbage was hauled to the incinerator where it was burned at a cost of $103,936.60, or $2.41 per ton. So the collection and disposal of garbage caused a total expenditure of $257,468.31, which figures the "bargain price" of $5.98 per ton.

Association of Public Works Officials Convention

The twelfth annual conference of the International Association of Public Works Officials will be held September 24, 25 and 26 at Hotel Pennsylvania, New York City. There will be discussions on snow removal, schools for public officials, sewage disposal, taxation, city planning, street lighting, municipal airports, uniform street sanitation records, and handling public works departments, led by prominent public works officials from Canada, Flordia, Rhode Island, Missouri and points between.

Storing Explosives

The two most important considerations in connection with the storage of explosives are the location of the magazine which contains them and the design of that magazine. The yardstick by which the location is fixed is the American Table of Distances, a table which indicates the distances that magazines containing given amounts of explosives should be located from inhabited dwellings, public railways and public highways. This Table of Distances, based upon actual explosions, may be had by writing this magazine.

All magazines should be located in compliance with the State laws. However, if the State law specifies a distance less restrictive than the American Table of Distances, or if no State law exists, the American Table of Distances should always be used.

The design of the magazine, for storing dynamite must cover three cardinal considerations: It must be weather-proof, fireproof and bullet proof. Magazines designed to store black powder must be weather-proof and fireproof. The problems of designing safe and suitable magazines for storing explosives are fully explained in a publication "Standard Storage Magazines," which will be sent on request.

Street Cleaning in Toledo

Some interesting figures were included in the annual report of the Division of Street Cleaning of Toledo, Ohio, for 1930. During that year 96,678,534 square yards of streets were cleaned, using 8,344,872 gallons of water at a labor cost of $278,961.80. Special street cleaning by white wings on eight city streets cost an additional $8,258.60, all of which is covered by special assessments. Three thousand four hundred fifty-four loads of refuse were removed from 6,574 catch basins at a labor charge of $19,328.40. Street cleaning caused a total of $372,385.29 to be paid out of the city funds, all of which is covered by special assessments.

Albany Health Recommendations

A public health survey of the city of Albany, N. Y., was recently completed by the State Board of Health at the request of Mayor Thatcher. Among the recommendations made as a result of the survey were: The transfer of garbage collection from the Bureau of Health to the Department of Public Works; the establishment of a Department of Health separate from the Department of Public Safety; the transfer of the plumbing inspection from the Bureau of Health to the Bureau of Buildings; the appointment of a full-time health officer; the creation of a Bureau of Milk Control; the continued employment of a full-time sanitary engineer; and the inauguration of a campaign of public health education.

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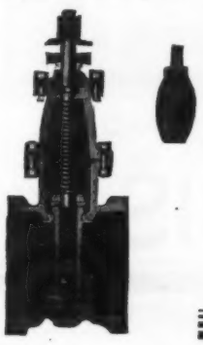

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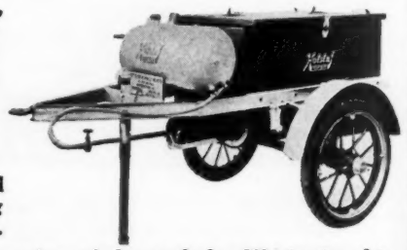

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Refuse Collection and Disposal

(Continued from page 22)

scattered over the entire face. As soon as possible after dumping organic refuse, such as garbage, the dumped material should be covered with ashes or earth. A fence around the dump, to prevent scattering of the waste by wind, is desirable. Salvaging should be controlled; if paper, bottles, and other materials are collected (which is almost universally the case), salvaging should not be allowed to interfere with the satisfactory disposal of refuse. Often treatment by oil or chemicals is necessary to prevent excessive fly-breeding at the dump.

When dumping is handled in this fashion, it will be fairly satisfactory; but it will be found to be at least as costly as other sanitary and desirable methods of disposal—incineration, for instance.

Dumping of inorganic materials, such as ashes, usually is the best method of disposal. In many cities they can be used for filling in low places close in, thus reducing the haul. But it is not possible to secure satisfactory results if garbage or organic refuse is dumped at one point and ashes or other cover material at another, unless soil or other suitable cover material for the garbage dump is available.

Burial is sometimes employed for the disposal of garbage. At least two feet of cover material is required to prevent nuisance, and the garbage should be treated, before covering, with crude oil or disinfectant solution to prevent fly-breeding, which will take place even under the earth cover.

Buried garbage decomposes slowly, and after a given area has been used for this purpose it can not be so used again until after a lapse of several years. After a year or two certain kinds of crops can be grown on it to advantage.

Feeding garbage to hogs, is employed in a large number of communities. This method of disposal necessitates the careful separation by the householder of garbage from his other wastes, and its collection alone, thus increasing the cost of collection. At the present prices of pork, garbage is worth about $2.50 per ton, less the costs of collection, hauling and labor in utilization. Since this sum will not pay for collection and utilization in most cases, there is no economy in this method of disposal at the present time. Moreover, it is exceedingly difficult to operate a hog farm satisfactorily and at a profit. Because of unavoidable odors, farms must be located far out, away from any habitations. From 35% to 50% of the original amount of garbage is refused by the hogs and remains on the feeding platform, and this material, which is highly offensive, must be disposed of promptly. Under present conditions, disposal by feeding to hogs is not a satisfactory method.

Incineration is the destruction of refuse by burning. The use of incinerators permits the collection of mixed refuse—that is, of all types of refuse mixed together, and therefore lessens the cost of collection. Such mixed refuse usually contains enough dry combustible material to provide the fuel necessary for burning the garbage. If garbage alone is burned, additional fuel will be required.

Incineration can be carried on without causing nuisance, even in close proximity to residences. This being the case, the incinerator can often be located near the center of population, thus reducing hauling costs. In a large community, two or three small

(Continued on page 82)

NEWS OF THE ENGINEERING FIELD

Engineering Societies

American Water Works Association

The 1932 convention of the American Water Works Association will be held at Memphis, Tenn., May 2-6. Headquarters will be at the Hotel Peabody.

Missouri Water and Sewage Conference

The Seventh Annual Meeting of the Missouri Water and Sewage Conference will be held in Jefferson City, Mo., October 22 and 23, 1931.

Herbert Bosch, State Board of Health, Jefferson City, Mo., is secretary-treasurer.

League of Pennsylvania Third Class Cities, City Engineers' Section

The first annual meeting of the Section was held August 18, during the thirty-second annual convention of the League, August 18, 19, 20, 1931, at Bradford. It was attended by eighteen city engineers and ten guests. Topics discussed included: Fighting unemployment with Construction of Planned Needed Public Works Properly Financed; The Relation of the City Engineer to Council and Other City Departments; Uniform Methods and Codes; Standards and Specifications.

Election of officers resulted as follows: President, J. Henry Quirk, city engineer, Bradford; Vice-President, Lyons Mussina, city engineer, Williamsport; Treasurer, E. Clark Cowden, city engineer, Harrisburg; Secretary, Francis J. Mulvihill, state municipal engineer, Harrisburg.

President Quirk appointed as Committee on Specifications and Codes, E. Clark Cowden, Harrisburg; B. B. Webber, Oil City; G. Hoskins, New Castle; and as Committee on Program on next meeting, M. E. Milliren, DuBois; C. F. W. Wallow, York; Thomas Finnie, Monessen; Committee on Constitution and By-Laws, Robert L. Fox, Bethlehem; Walter P. Johns, Wilkes-Barre; Frank E. Maddocks, Greensburg.

Personal Notes

Eugene Keller, Jr., until recently district manager of the Philip Carey Company, at Memphis, Tennessee, has been appointed a regional manager of the Armco Culvert Manufacturers' Association, Middletown, Ohio. He will be responsible for region No. 4, which includes: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North and South Carolina, Oklahoma, Tennessee and Texas.

The Blaw-Knox Company announces that Nicholas Gerten, formerly vice president of the Blaw-Knox International Corporation of New York City, has been elected president of that organization. Mr. Gerten joined the Blaw-Knox organization in January, 1928, as sales manager of the Blaw-Knox International Corporation. He was formerly an engineer in the Technical Department of the Mitsubishi Company in New York and prior to that was with the Allied Machinery Company, a subsidiary of the American International Corporation, engaged in the export of American machinery.

The Worthington Pump and Machinery Corporation, Harrison, N. J., has acquired the manufacturing and marketing facilities of Metalweld, Inc., Philadelphia, Pa., builders of a complete line of portable compressor units. For many years Worthington has been a leader in the compressor industry. Last year it took over the manufacture and sale of Gilman rock drills and accessories. This together with the added line of portable and semi-portable compressors and other tools, will enable Worthington to supply all air equipment requirements of contractors, railroads, utilities and industrial users. Worthington's Feather Valve compressors always have been an integral part of Metalweld portable units. It is a natural step, therefore, for Worthington to acquire the manufacture of the complete product. The portable compressors will be manufactured at the Harrison, N. J., works of the Worthington Pump and Machinery Corporation, and the engineering, manufacturing and sales personnel of the Metalweld organization will be located there.

Headley Emulsified Products Co., Franklin Trust Bldg., Philadelphia, Pa., announce the appointment of J. G. Campazzie as vice-president, directing sales.

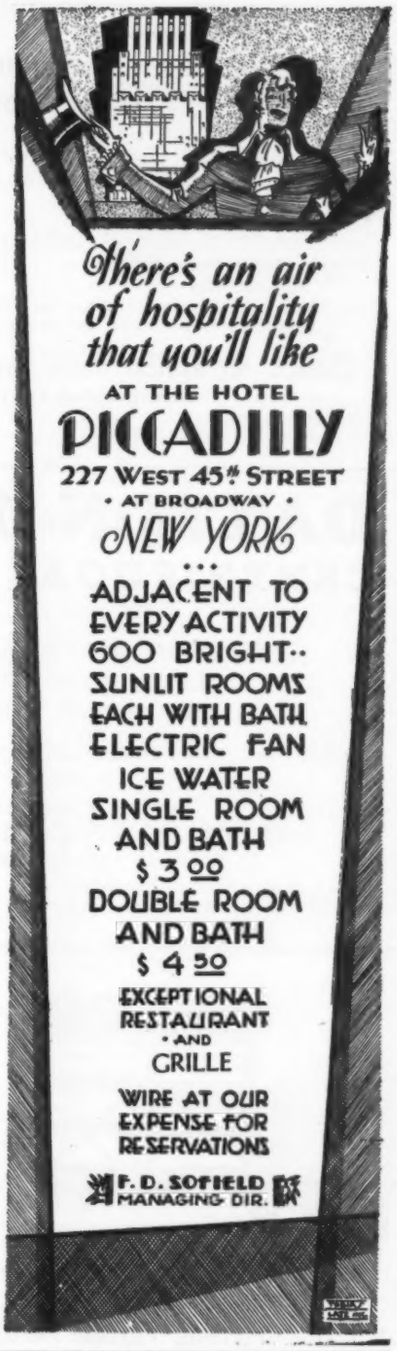
Following the death of C. D. Fleming, Vice President of The Cleveland Tractor Company, his former duties as Director of Domestic Sales have been assigned, in accordance with certain territorial divisions, to W. E. Miles, G. W. Pickering and H. E. Orr, who have been made District Sales Managers. W. E. Miles controls all of the territory from a line running between Chicago and New Orleans eastward to the coast. G. W. Pickering handles all of the territory from a line running from western boundary of North Dakota to western boundary of Texas, east to western line of eastern territory. H. E. Orr has charge of the territory from eastern boundary of Montana to eastern boundary of New Mexico, west to Pacific Coast.

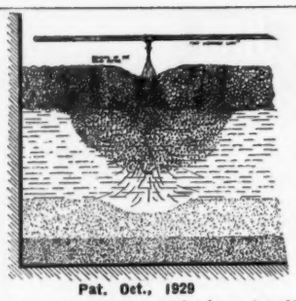
These three men have been sales assistants to Mr. Fleming for several years, so are well trained and thoroughly competent to take over the full responsibilities of sales manager in their respective territories.

Mr. Pickering, in addition to handling the Central District in the United States, will also be in charge of Cletrac sales in the Dominion of Canada.

Mr. Orr will continue as Advertising Manager, along with his directional work on sales in the Western District.

Orlando Ware, Treasurer of James B. Clow & Sons, Chicago, died Sunday, August 2nd, at the age of 72, after more than thirty years' continuous service with that firm. Mr. Ware's death will be felt keenly by a host of plumbers and contractors who have bought from Clow. It was always Mr. Ware's policy to assume that there were two sides to every collection and credit problem. By facing these two sides sympathetically and understandingly, Mr. Ware gained a confidence that few men in his position have known.





Pat. Oct., 1929

Squirting Sewage Into Sewage

Application For All Methods of Sewage Treatment

Aeration
Mild or Violent Agitation
Circulation

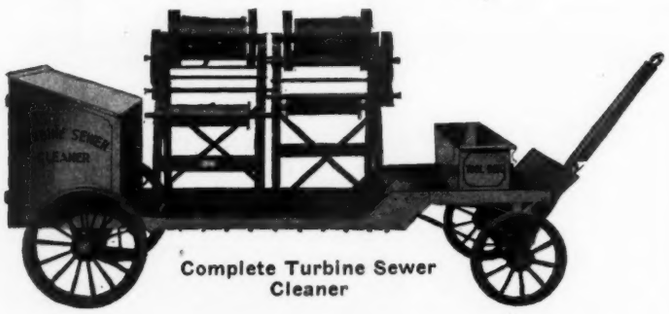
Also Used for Chlorine Application Giving Instantaneous Chemical Reaction in Minus Oxygen Sewage

Chemco - Mechanical Water Improvement Co.
Incorporated 1917
P. O. BOX 0-3400, Philadelphia, Pa.

DAYTON-DOWD
CENTRIFUGAL PUMPS
FOR
Waterworks and Filtration Plants
Sewage Disposal Plants
Sewage Relift Stations

Designed and built by Centrifugal pump specialists of long experience

MANUFACTURED BY
DAYTON-DOWD COMPANY, Inc.
WORKS—QUINCY, ILLINOIS
SALES OFFICES IN 51 CITIES



Complete Turbine Sewer Cleaner

Self Propelling Ferret Turbines, Windlasses
Adjustable Turbine Sewer Cleaners
Sewer Braces (Cable Guides)
Drag Type Sewer Cleaners
Five Types of Sewer Rods
Sewer Cables
Conduit Rods

Send for catalog and prices

TURBINE SEWER MACHINE COMPANY
5210 W. State Street Milwaukee, Wisconsin

units can be so located as to reduce the average haul to a minimum.

Modern types of incinerators can be installed at a relatively small first cost, and can be operated satisfactorily without skilled labor. They are available in various sizes, suitable for a community of any size. The cost of operation may approximate $1 per ton of refuse, which is considerably cheaper than the cost of satisfactory disposal by other means in many localities In many cases, it is possible for two or more nearby communities to cooperate in the construction of an incinerator; or one community may build a plant of adequate capacity and arrange to incinerate the refuse of nearby communities at a flat rate per ton.

Proper incineration reduces absolutely all organic matter to a cinder which is excellent for walk foundation, concrete aggregate, or filling low ground; thus preventing nuisance with due attention to economy, cleanliness and health.

How a Modern Water Supply Saved Lake Odessa

(Continued from page 28)

feel vindicated in ordering this tank for our town, and I trust that our valuable experience in providing ample water storage in the "nick of time" will also help other towns that are today in a dangerous situation as regards their water supply.

Mr. Ritter is still in charge of our town's water supply. I am a private citizen and in business as proprietor of the Lake Odessa Produce Company. Mr. Ritter advised me in July, 1931, that our cost records show the complete operating cost of our new modern water system for the past year was under $3,700, or an actual savings of more than $4,000 over that of our former antiquated and inadequate supply. These substantial operating savings *alone* have fully paid for the cost of our water tank since its erection in 1928.

Today we are all proud of our modern water system. Several towns and villages nearby have sent delegations to inspect it at various times. All have spoken very highly of it—many stating it to be the most complete water system for its size in the state of Michigan. I shall feel well repaid if our experience in providing a good water system for our village will help other towns do the same.

The fire which almost destroyed Lake Odessa.

TO HELP YOU IN YOUR WORK, ANY OF THIS

INDUSTRIAL LITERATURE

WILL BE SENT **FREE** UPON REQUEST

It is a good practice to check this list regularly because descriptions of new bulletins are always being added.

Construction Methods and Equipment

Accessories, Motor Truck

1. Truck accessories—winches, power take-offs, derricks, special bodies, earth boring machines, and trailers of all capacities are described in a series of folders issued by Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Asphalt Heaters

8. A 54-page booklet issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illutsrates oil, wood and coal burning asphalt and tar kettles, tool heaters, sand dryers, tool boxes, traffic line markers, grout mixers, asphalt tools and their use in road construction.

9. "Hotstuf," the master oil burning heater, is the only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Described in illustrated manual No. 11—Mohawk Asphalt Heater Co., 94 Weaver St., Schnectady, N. Y.

Asphalt Plants

10. J. D. Farasey Mfg. Company, Cleveland, Ohio, issue a booklet for use and specifications for Farasey Portable Asphalt Paving Plants. These R. R. 1-car plants have easy capacity of 2,250 yards, 2" surface per 8 hours. Cheap to operate.

Asphalt Rollers

12. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Issued by the Erie Machine Shops, Erie, Pa.

Clamshell Buckets

27. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Clamshell Buckets showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Clamshell Buckets will also be furnished on request.

28. The Blaw-Knox Company, P. O. Box 915, Pittsburgh, Penna. publishes a 32-page catalog descriptive of all types of Blaw-Knox Dreadnaught Clamshell Buckets, No. 1234, illustrating various construction features and giving a complete list of types and sizes. A complete catalog on Blaw-Knox Dragline Buckets, No. 1247, will also be sent upon request.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully the subjects suggested by its title. A well-illustrated and instructive volume.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Published by the Solvay Sales Corp., 61 Broadway, New York, N. Y.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Building Construction, Bridges, Culverts and Concrete Products." Concise practical data, embodies latest information on subject. Issued by Columbia Products Co., Barberton, Ohio.

Concrete Mixer

44. Jaeger Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size, with illustrated descriptions of all types mounting, power and loading equipment—64 pages published by The Jaeger Machine Company, Columbus, Ohio.

Crushers

56. Pioneer Gravel Equipment Manufacturing Company, Minneapolis, Minnesota, publishes complete 80-page manual, showing blue print sketches of set-ups in pit or quarry of the eleven different sizes of Pioneer Crushing Plants.

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Galion Iron Works & Mfg Co., Galion, Ohio.

Culverts—Large Diameter

59. The Toncan Culvert handbook, containing 56 pages of typical Toncan Culvert installations and much valuable data pertaining to all kinds of drainage problems, will be gladly sent free upon request. Address Toncan Culvert Mfrs. Assn., Massillon, Ohio.

60. Ease and speed of installation, economy, a full-width roadway and durable, maintenance-free service, are listed in the new catalog, "Armco Large Diameter Corrugated Pipe," as the advantages following the use of larger diameter culverts in meeting small bridge requirements. Catalog No. 8 will be sent free on request. Address Armco Culvert Mfrs. Association, Middletown, Ohio.

Drag Lines

61. Write for complete catalog on Pioneer Drag Line. Catalog shows cross section of Drum Unit with full description of Frame, Sheaves, Motor and Bucket.—Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.

Dump Wagons, Steel

70. Steel Dump Bodies and hydraulic hoists for Fords and other small trucks are described and fully illustrated in technical literature published by the Wood Hydraulic Hoist and Body Co., 7924-60 Riopelle St., Detroit, Mich.

71. "Steel Dump Bodies." Full data on steel dump bodies for every type of hauling proposition and description of special "Self-Dumper Bodies" for road Builders. Wood Hydraulic Hoist and Body Co., 7924-60 Riopelle St., Detroit, Mich.

Finishing Machine

74. The Blaw-Knox Company, P. O. Box 915, Pittsburgh, Penna. publishes Bulletin No. 6, completely descriptive of the Ord Road Finisher and its application to the finishing of all types of concrete and asphalt pavements. This bulletin will be sent upon request.

75. Complete description of Lakewood Finishers, showing use of single and tandem screeds and tamper attachment for high speed production on concrete and bituminous pavements, city streets and highways—32 pages published by The Lakewood Engineering Company, Columbus, Ohio.

Graders

76. Elevating Graders. Two publications by the Caterpillar Tractor Co., Peoria, Ill., illustrate the Caterpillar Sixty Grader with and without engine.

Excavating Buckets

80. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Excavating Buckets showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Excavating Buckets will also be furnished on request.

Hammers, Self-powered

82. A new bulletin describing and illustrating the use of RODAX, a portable self-powered, gasoline driven hammer, has just been issued by the Rodax Corp., 2199 Lumber St., Chicago, Ill.

Hoists, Truck

85. "Dump Truck Hoist." Double the Truck's value by using power operated Hydraulic Hoists. Catalog of WOOD Hydraulic Hoist and Body Company. Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service available from the Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

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Please send me without obligation the following catalogs listed under INDUSTRIAL LITERATURE SECTION:

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Lanterns and Torches

90. Send for interesting catalog in colors of Dietz Lanterns and Road Torches adapted for night traffic warning on any construction work that obstructs the highways. R. E. Dietz Co., 60 Laight St., New York, N. Y.

91. An illustrated folder in two colors has just been printed describing the Toledo Torch for illuminating hazards on highway and other construction. Issued by the Toledo Pressed Steel Co., Toledo, Ohio.

92. "Setting a New Standard of Torch Efficiency" is the title of a new folder giving full details concerning specifications of the Cleveland Flaming Torch. Includes illustrations of the special burner. Just issued by the Consolidated Iron-Steel Mfg. Co., 1290 E. 53rd St., Cleveland, Ohio.

Loaders and Unloaders

97. Link-Belt Company, Philadelphia, describes a line of Portable Loaders and Unloaders in Folders: Nos. 1073 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket Elevators for different classes of work; and No. 1149, the "Grizzly" Crawler Loader for heavy work and large capacities.

100. Link-Belt Co., Chicago, Ill. General Catalog No. 500, describing the entire line of Link-Belt Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery.

Motor Trucks

106. "Operating Trucks Profitably in Contracting"—A 24 page survey with practical data on efficient truck operation and what to consider in selecting new equipment just published by General Motors Truck Company—Pontiac, Mich.

107. The new "Operating Record for Motor Trucks" just issued by Dodge Brothers Corp., Detroit, Mich., is one of the most complete record books available. It includes the necessary forms and directions for a very accurate and detailed accounting of Motor Truck operations.

108. Four-wheel-drive trucks to increase the range of truck operation and for economy of operation for use in road building and maintenance, described in a series of new folders just issued by Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Paving Materials

109. A 36 page booklet with 66 illustrations has just been issued by the Barrett Co. giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. Profusely illustrated with photographs, 24 pages. The Barrett Company, 40 Rector Street, New York.

Power Graders

117. A large wall display piece, No. 3101, printed in three colors and containing a very large illustration of the WARCO Model "E" power grader as well as complete description and working views on center control graders will be sent by the W. A. Riddell Co., of Bucyrus, Ohio, to anyone interested.

Pumps, Contractors'

120. Humdinger contractors' pumps. Diaphragm pumps in both the open discharge and the diaphragm force pump types. Self-priming Centrifugal pump, for automatic continuous prime on suction lifts up to 28'. Are described fully and valuable practical information for contractors is given in special Bulletins #107-A and 1034. Ralph B. Carter Co., 53 Park Place, New York, N. Y.

Road Construction

121. "Road Construction and Maintenance" are covered in a new Cletrac Booklet, which takes up such subjects as modern methods of handling large capacity equipment, tandem equipment, etc. Cleveland Tractor Co., 1932 Euclid Ave., Cleveland, Ohio.

122. Building Roads Better, Cheaper and Quicker. A book by the Caterpillar Tractor Co., Peoria, Ill., telling how smooth, well-built roads can be built better, cheaper and quicker. It pictures the machines which do this work, and tells how the machine's economy, dependability and stamina are important.

Road Rollers, Scrapers, Graders, etc.

124. The Blaw-Knox Company, P. O. Box 915, Pittsburgh, Penna. publishes Bulletin No. 1310 descriptive of Blaw-Knox Dirt Moving Equipment including the Blaw-Knox "Ateco" Dirt Mover, the Blaw-Knox Wagon Grader, Scarifiers, Bulldozers and Tamping Rollers. This bulletin contains a complete description of the equipment and valuable cost data on dirt moving. It will be sent upon request.

126. Illustrated catalogs and descriptive material HERCULES All-steel, 6-cylinder road roller. 60 H.P. Gasoline engine. Sizes 5, 7, 8, 10, 12, and 15 tons. Three speeds forward and backward. Cast Steel rollers. The Hercules Company, Marion, Ohio.

127. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Issued by the Erie Machine Shops, Erie, Pa.

128. A beautiful 32 page book in four colors featuring their entire line of road rollers has been published by the Buffalo-Springfield Roller Co. of Springfield, Ohio. 8¾ x 11, leatherette cover, numerous action pictures.

129. Caterpillar publications as follows: Sixty Leaning Wheel Grader, the Super-Special Grader, the Motor Patrols, the Twenty Planer, the Hi-Way Patrol Grades No. 3, the Ten Motor Patrol, and the Auto Patrol. These cover a wide range of valuable and useful information on road-building machinery. Caterpillar Tractor Co., Peoria, Ill.

131. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers. The Buffalo-Springfield Roller Company, Springfield, Ohio.

132. "Road Machinery." A sixty-four page data book has been issued by the Austin-Western Road Machinery Company, 400 No. Michigan Ave., Chicago, describing their full line of road building machinery. Included in it are illustrations and descriptions of road graders, 5-foot blade to 12-foot blade; road rollers, steam or gasoline powered, 3 to 15-tons single cylinder to four cylinder. Motor graders, three sizes. Scarifiers. Crushing plant equipment, small road tools. Special bulletins on each separate piece of machinery supplement the general catalog.

133. "Road Rollers." New illustrated booklets covering the entire line of Master 4-Cylinder motor roller, 4-cylinder tandem roller and International motor roller. Gallon Iron Works and Manufacturing Co., Gallon, O.

134. 36-page, illustrated book describing mechanical features of Huber 4-cylinder Motor Roller and its application to many types of road construction and maintenance. Huber Mfg. Company, Marion, Ohio.

135. Road Machinery Illustrated. New illustrated bulletins on the master Motor Roller, Three-Wheel and Tandem Rollers, Motor Graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and Straight and Leaning Wheel Graders. Gallon Iron Works & Mfg. Co., Gallon, O.

136. Full description of Huber Motor Rollers in sizes from 5 to 15 tons, included in durable 36-page book for use by road contractors and maintenance crews. Huber Mfg. Co., 345 E. Center St., Marion, Ohio.

137. Road Machinery. Comparative specifications of the various types of equipment manufactured by the Caterpillar Tractor Co., Peoria, Ill.

Sand and Gravel Washing Plants

138. The Dorrco Sand-Washer is inexpensive to install and operate, and produces a clean, drained sand with a minimum of waste. It will make separation at any point between 20 and 100 mesh. Ask for bulletin No. 4101. The Dorr Co., 247 Park Ave., N. Y.

139. Up to date information on Portable Sand and Gravel Washing Plants with concrete capacities, ranging from 30 to 100 yards per hour.—Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.

Screens

140. Full information concerning Shaker and Revolving Screens, Conveyors, Elevators, Bins and Chutes is contained in catalog and special illustrated folders on Pioneer line. Write Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.

Shovels, Cranes and Excavators

142. The Cranemobile, "successor to Trench Cranes," an adaptation of the crawler mounted Bay City Tractor Shovel is fully described and illustrated in Bulletin C2 just issued by Bay City Shovels, Inc., Bay City, Mich.

145. Catalog K3 just issued, completely describes the light half yard and the full half yard convertible shovel, crane, dragline, trench hoe and skimmer manufactured by Bay City Shovels, Inc., Bay City, Mich. 28 pages, over 50 illustrations, action pictures and charts.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines.

151. The complete line of ½-yd. to 1½-yd. shovels, cranes, draglines, ditchers and skimmers manufactured by the Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill., is described in Bulletin 60, which also gives lifting capacities and working ranges for the different sizes and types of these crawling tread machines.

Steel Forms

155. A well illustrated catalog of Steel Forms for concrete road, curb and sidewalk construction is available from The Heltzel Steel Form & Iron Company, Warren, O.

Steel Bins

159. Steel bins and measuring hoppers are included in a fully illustrated catalog of Contractors Equipment issued by The Heltzel Steel Form & Iron Company, Warren, Ohio. Write for your copy.

Steel Posts

160. Steel Posts for all purposes. Sweet's Herculean Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport, Pa.

Steel Storage Bins

162. The Blaw-Knox Company, P. O. Box 915, Pittsburgh, Penna. publishes Catalog No. 1302, descriptive of the complete line of Blaw-Knox Contractors Equipment including steel storage bins, measuring equipment for proportioning concrete aggregates, cement and water, ready-mixed concrete plants, trukmixing and agitator bodies. This catalog will be sent upon request.

Surveying Instruments

163. A complete catalog and instruction book pertaining to the "Sterling" illustrated, is now ready for distribution by the Warren-Knight Co., 136 No. 12th St., Philadelphia, Pa.

SWEETS STEEL POSTS

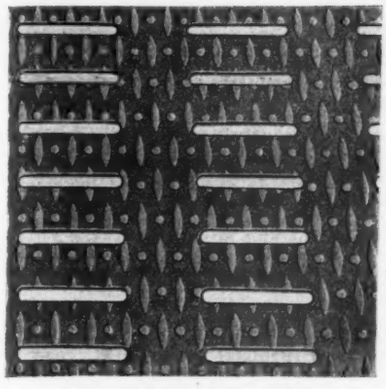
Available in ten standard lengths varying from 5 to 9½ feet in length and in four standard weights.

No separate parts are required to attach fencing—adaptable to any type of wire fencing.

SWEET'S STEEL COMPANY *Write for Descriptive folder.* **Williamsport, Pennsylvania**

Economical Equipment

Recent Developments Briefly Reviewed



A new kind of floor grating

Something New in Floor Grating

The Central Iron & Steel Company of Harrisburg, Pa., has developed and placed on the market an improvement over the ordinary fabricated floor grating. They have designated it their slotted floor plate.

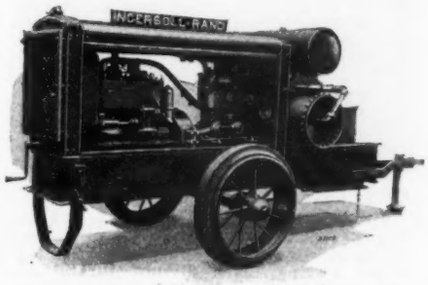
These slotted floor plates can be furnished in almost any gauge and size up to 72″ x 240″. In addition to being absolutely non-skid, this new slotted floor plate allows free ventilation, free drainage, passage of light and reduced weight. One or more of these qualities obviously recommends its use for fire escapes and exterior platforms; flooring and galleries in industrial plants where trapped fumes, gases or heat may produce a hazard; walkways around presses where light is valuable; and any other place where gratings have heretofore been used.

New I-R "Speed Trailer" Portable Air Compressor

The "Speed Trailer," a portable air compressor designed for high-speed towing, is a new addition to the Ingersoll-Rand line. It consists of a standard 5½ x 5-inch gasoline-engine-driven compressor mounted on two rubber-tired steel wheels. Because of the low center of gravity, it can be towed behind a truck on a good roadway at 30 to 35 miles per hour. When detached, it can be moved about by one man. It is especially adapted to quick service jobs by public utility companies, street departments, etc.

The complete "Speed Trailer" is 13 ft., 10 ins. long; 6 ft. wide; and 5 ft., 9 ins. high. It has a piston displacement of 120 cu. ft. per minute and is designed for a working pressure of 100 pounds per sq. in. Removable steel side doors permit enclosing and locking the unit when it is not in use.

Operating features include an "air-sealed" compressor unloader, "air-sealed" engine speed controller, after-



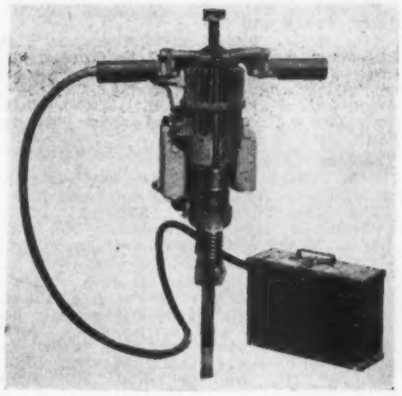
I-R Speed-Trailer

cooler, and Type "K" plate valves. Complete information may be obtained from Ingersoll-Rand Co., 11 Broadway, New York City.

Rodax Gas Hammer

The Rodax Corporation of Chicago, Illinois, has recently placed a new model hammer on the market. This new design is eleven pounds lighter and weighs but 26 pounds. However, this hammer has considerably more power than their former model.

They have eliminated the oil cooling



New Rodax gas hammer.

chamber with the horizontal and movable fins and are cooling the cylinder by a design which is air cooled with vertical fins. This is mentioning only a few of the ingenious features appearing on this hammer.

Due to its portability it is rapidly gaining favor. A number of states are specifying that all highway work be mechanically tamped, and a number of contractors without equipment to do this work have purchased Rodax.

This simple and unique two-cycle hammer, which is complete in itself and needs no additional equipment, is now being used where formerly it was either impossible or uneconomical to use large mechanical equipment.

The Camel Tractor Dump Wagon

The Shunk Mfg. Co., Bucyrus, O., in the Camel Dump Wagon have brought out a unique and valuable tool for the contractor. It is a 5-yard crawler dump wagon, operating under its own power. It is also a bulldozer. A great advantage when working in constricted quarters is that no turning is necessary. The Camel can be driven forward and backward with equal facility. The driver simply changes seats. While ordinarily equipped with crawlers, steel wheels or pneumatic tires may be used equally well.

Caterpillar "20" and new leaning wheel grader.

The Camel Tractor Dump Wagon and Bulldozer.

Tires, Truck and Car

165. Solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Full information and data available from Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Tractors, Crawler

168. "High Clearance," "Caterpillars in Mines, Quarries, Clay Plants and Pits," "The Caterpillar for Industry," "The Caterpillar for Railroads," "For the Earth Mover," are publications of the Caterpillar Tractor Co., Peoria, Ill.

169. Cletrac crawler tractors. Cleveland Tractor Co., 19322 Euclid Ave., Cleveland, O. Bulletin 562 describes their use in roadbuilding and maintenance, earth moving, excavating, grading, snow removal, oil field work and lumbering. Made in "20," "30," and "40" and "100" sizes.

170. "Roads," a series of five fully illustrated folders, prepared by the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill., shows what Russell graders and "Caterpillar" tractors can do and are doing to build better roads quicker and cheaper.

171. The design, construction, details and complete specifications of the new Ten and Fifteen models "Caterpillar" are given in a booklet recently published by the Caterpillar Tractor Co. of San Leandro, Calif., and Peoria, Ill.

172. The Caterpillar Sixty Tractor. This beautifully illustrated booklet tells the story of the Caterpillar Sixty Tractor design and construction. Caterpillar Tractor Co., Peoria, Ill.

173. Cletrac Crawler Tractors are built in a complete line by The Cleveland Tractor Company, 19322 Euclid Ave., Cleveland, Ohio. Cletracs range in size from the 12 h. p. model to the powerful 100 h. p. tractor.

Truck Cranes

182. Full-revolving, gasoline-operated Truck Cranes with a capacity of 7½ tons at a 10 ft. radius, for mounting on a 5-ton or 7½ ton auto-truck, are described in Bulletin 62, issued by the Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill.

Truck Hoists

183. "Dump Truck Hoists." Double the Truck's Value by using power operated Hydraulic Hoists. Booklet published by WOOD Hydraulic Hoist and Body Company, 7924 Riopelle St., Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

Wheeled Scoops

190. The WARCO wheeled scoops, claimed to offer the most economical handling of earth on short hauls, is fully described and illustrated in Bulletin No. 3102 issued by the W. A. Riddell Co., of Bucyrus, Ohio. Printed in three colors and fully illustrated—will be sent to anyone interested.

Road and Street Maintenance

Asphalt Heaters

201. Tar and Asphalt Kettles, Oil Burning Kettles, Pouring Pots, Torches and Hand Spraying Attachments. Full data. Connery & Company, Inc., of Philadelphia.

202. Connery & Company, Inc., 3900 N. Second St., Philadelphia, Pa., has issued a new Bulletin "J" describing the latest and improved style "J" Oil Burning Kettle for Paving Contractors, Street and Highway Departments.

203. A 54-page booklet issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates oil, wood and coal burning asphalt and tar kettles, tool heaters, sand dryers, tool boxes, traffic line markers, grout mixers, asphalt tools, etc.

Dust Control

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance. It contains tables and composition, grading, etc.

211. "Dust Control," a concise, handy pocket reference on control of dust by use of 3C Calcium Chloride. Illustrated. Issued by the Columbia Products Company, Barberton, Ohio.

Dust Laying

213. Solvay Sales Corporation, New York, supplies full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost.

Equipment

215. "Road and Street Maintenance Equipment," a compact vest pocket manual containing illustrations and brief descriptions of their extensive line, has just been issued by Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

216. "Light and Heavy Road Maintenance" is the title of a recent folder showing the tremendous power developed by the FWD truck and its economy for use in pulling road graders and maintainers—issued by Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Highway Mowers

217. A new Motor Sickle Highway Mower, cutting from eight to twenty miles per hour, has been designed for mowing highways. Has a cruising speed while not mowing up to fifty miles per hour over smooth surface roads. Full details on construction and operation from Rawls Mfg. Co., Streator, Ill.

Surface Heaters

218. The new "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is fully described and illustrated in Bulletin 16 just issued by the Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Road and Paving Materials

Brick, Paving

230. Full information and data regarding the use of vitrified brick as a paving material may be obtained from the National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. A handy, useful volume, well illustrated. 47 pages, 5½x7½. The Dow Chemical Company, Midland, Mich.

Culverts, Corrugated

236. The Toncan Culvert handbook, containing 56 pages of typical Toncan Culvert installations and much valuable data pertaining to all kinds of drainage problems, will be gladly sent free upon request. Address Toncan Culvert Mfrs. Assn., Masillon, Ohio.

Culverts—Corrugated Metal

238. A new 24-page, well-illustrated catalog, listing the advantages that follow the use of Armco corrugated iron culverts and containing complete instructions for ordering and installation has been published by Armco Culvert Mfrs. Association, Middletown, Ohio. Write for Culvert Catalog No. 6.

Expansion Joint for Pavements

251. Full information on the use of Expansion Joints in pavements, bridges, pools, walls and other concrete work, including best installation methods, may be obtained from The Philip Carey Company, Cincinnati, Ohio.

Jacking Method

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passageways under streets, highways and railroads. A new catalog, "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

Maintenance Materials

267. "Mixed-in-Place Construction with Tarmac." Step-by-step pictures and specifications for constructing road surfaces by Retread or Turnover methods. American Tar Products Co., Koppers Bldg., Pittsburgh, Pa.

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control. It contains tables of composition, grading, etc.

272. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products is now ready for distribution. Recently published by the Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

273. Complete directions for surface treatment and bituminous surfacing with Cut Back Asphalt are contained in a 36 page data book just issued by the Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with "Tarvia-K. P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

277. "Tarvia." An attractively illustrated 32-page booklet describing grades of Tarvia and showing photographs of actual application. The Barrett Company, 40 Rector St., New York City.

Material Handling Buckets

280. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Material Handling Buckets, showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Material Handling Buckets will also be furnished on request.

Sand and Gravel Buckets

290. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Sand and Gravel Buckets showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Sand and Gravel Buckets will also be furnished on request.

Garbage and Refuse Disposal

304. The Holzbog line of sanitary wagons especially designed for low cost collection of wet or dry garbage and refuse is fully described and illustrated in a 16 page catalog published by Geo. H. Holzbog & Bro., Jeffersonville, Ind.

305. "Pittsburgh-Des Moines Incinerator," built and guaranteed by the Pittsburgh-Des Moines Steel Company, 3479 Neville Island, Pittsburgh, Pa., is described fully in a booklet sent on request.

Snow Removal

Snow Fences

347. A new folder giving full details regarding use and construction of the Mattson snow fence has just been issued by the Mattson Wire & Mfg. Co., Joliet, Ill. Illustrated in two colors.

Snow Removal

348. "Winter Maintenance" is the title of a recent booklet issued by Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin. Illustrates many types of snow plows and methods of handling snow removal problems.

349. "The Answer to the Snow Removal Problem" is the title of a new booklet just published by Carl Frink, Mfr., of Clayton, N. Y. It gives full details of the new Frink type S snow plow for trucks.

353. Efficient methods of combating quickly the snow menace on highways and city thoroughfares. Illustrates joint use of crawler tractors and standard and special snow plows. The Cleveland Tractor Co., 19322 Euclid Ave., Cleveland, Ohio.

354. "Snow Removal Equipment," a colorful booklet just off the press of the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill. Various types of snow-fighting equipment built for "Caterpillar" Tractors are pictured in relief and in action.

Highway and Construction Equipment

Cleveland Tractor Company Gets Huge Order

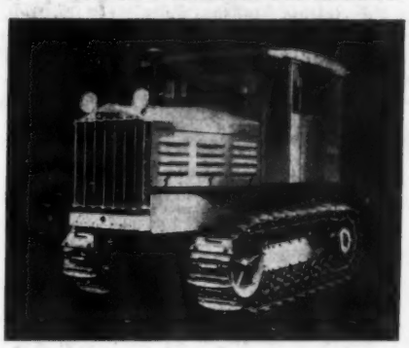
What is probably the largest single tractor order ever placed at one time by any state has just been received by the manufacturers of Cletrac Crawler Tractors; 125 crawler type tractors are called for in Pennsylvania's present program and the entire contract was awarded to Cletrac.

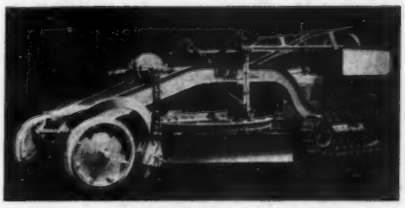
As a direct result of this order, approximately 500 men have been returned to work by the Cletrac company, not to mention the many jobs that will be created in other companies who supply materials and special equipment to Cletrac.

This is but one instance of what Governor Pinchot's "good roads" program will do to help unemployment both in Pennsylvania and other states. More than one hundred million dollars has been appropriated, out of which a few millions will be spent for new highway equipment alone. The balance is to be used in building 20,000 miles of new roads and for the improvement of 11,000 miles of present highways.

This great road program has been launched under the slogan of "Get the farmers out of the mud" and it is expected to be completed within two years.

(Since this was written, The Cleveland Tractor Company has received a second order for 28 more Cletrac "80-60's" from the same source, which brings the total Cletracs ordered by Pennsylvania to 153.)





The equipment included in the Cletrac order. Above—the 80-60 Tractor with headlights, spotlights, muffler and cab. Below—Cletrac Powered Galion Motor Patrol.

Mowing at 20 Miles per Hour

The new Rawls Motor Sickle Mower, Type 31, like previous Rawls mowers, is drawn by an automobile, truck or tractor, at speeds up to 20 miles an hour, but the cutter bar is driven independently by a gasoline engine mounted on the mower. Thus the speed at which the cutter bar operates is not dependent in any way on the speed at which the mower is drawn. The sickle speed is instantly and easily changed to any desired speed up to 1,200 R.P.M. by means of convenient throttle control. This makes it possible to cut heavy vegetation that would stall a horse-drawn mower, by speeding up the rate that the cutter bars operate.

The speed is not the only revolutionary feature of this new Rawls mower. Particularly noticeable is the absence of gears, drive shafts, universal joints, brackets, etc.—wearing parts which otherwise cause heavy maintenance expense and limit the speed of the cutter bars of an ordinary mower. In place of this complicated driving mechanism, the Rawls Motor Sickle Mower, Type 31, has a simple twin Vee Belt drive to a Pitman Wheel, from a 3 h.p. gasoline motor.

The frame of this mower is of structural steel reinforced and welded, and unlike previous mowers available for cutting highway vgetation it has wire wheels and pneumatic tires.

The cutter bar can be furnished in either 5 or 6 ft. length and will cut at any angle from straight up to 45 degrees downward, and this angle can be changed at will by the operator while the machine is mowing. The cutter bar has an automatic spring trip which allows the cutter bar to swing back alongside the frame if the cutter bar hits an obstruction. This eliminates breakage and dulling of the cutter bar.

The toe-hitch for coupling onto an automobile, truck or tractor is adjustable to different heights, and this mower has a cruising speed up to 50 miles an hour over smooth surfaced roads when not mowing.

This modern equipment is put out by the Rawls Mfg. Co., Streator, Ill.

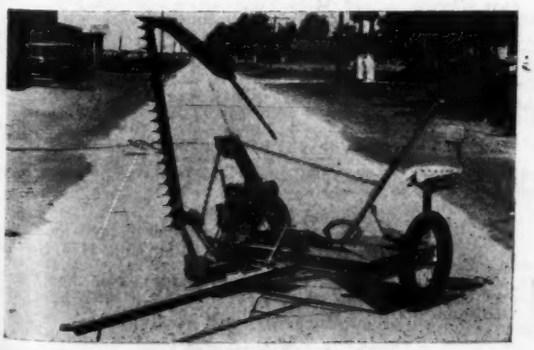
Armco Cribbing for Retaining Walls

The American Rolling Mill Company of Middletown, Ohio, has just announced another new and interesting use for sheet-metal. This is the recently-developed Armco Ingot Iron Cribbing for retaining walls.

The new metal cribbing is of a simple yet effective design. The wall is built up from standard formed galvanized sections, either six or eight feet in length, and held together by a sturdy interlocking device. Exhaustive experimental tests have been made for compression, shearing and bending of the units, both separately and when locked together.

From the engineering standpoint there are numerous advantages. First and foremost, is economy of installation, as well as greater speed. The wall is in service as soon as installed, without waiting an interval for curing. The units are but one-fourth the weight of other known designs. This reduces transportation costs, and reduces the factor of expense in handling. It also eliminates the necessity for special handling equipment. The wall may be erected by unskilled labor.

Because the units are light in weight, they can be placed on foundation soils which would require a pile or caisson sub-foundation if a heavy mass wall were constructed.



The new Rawls Mower is built for fast work, and will operate at speeds up to 20 miles an hour.

Cutting approximately 45 degrees upward. This machine will cut from straight up to 45 degrees downward.

355. "Conquering Snow With Caterpillars." "An Unwelcome Visitor Is Coming." "A Wall Ten Miles High." Three publications on the snow problem by the Caterpillar Tractor Co., Peoria, Ill.

358. The new Type "S" Frink Sno-Plows and Frink Leveling Wings, together with complete data for selecting the proper size snow plow for your particular make and model of truck. Published by Carl H. Frink, Clayton, N. Y.

359. Galion Iron Works and Mfg. Co., Galion, Ohio, will gladly furnish details, prices and catalogs of their snow plows adaptable to any make of truck.

Sewerage and Sewage Disposal

Activation and Aeration

390. A new booklet describing Norton Porous Mediums of bonded fused alumina (strong, chemically stable, uniformly permeable), the booklet will be of interest to all chemical and sanitary engineers. Issued by Norton Co., Worcester, Mass.

Inlets and Manhole Covers

400. Cast iron sewer blocks, ventilators, manhole covers and inlets, valves, etc., described in pamphlet by the South Bend Foundry Co., South Bend, Ind.

Jointing Materials

401. G-K Compound for vitrified clay sewers, MINERALEAD for bell and spigot water mains, also M-D Cut-Ins for making house connections, described in catalogue of Atlas Mineral Products Company, Mertztown, Pennsylvania.

Sewer Joint Compound

404. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight are contained in an illustrated folder just issued by the Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Pipe, Vitrified

405. Full information regarding Vitrified Pipe and other heavy clay products. Illustrated price list on application. Factories in Pennsylvania and Ohio. The Progressive Clay Co., offices in New York City, Philadelphia, Pa., and Syracuse, N. Y.

Pumps—Sewage

410. Non-clog vertical and horizontal sewage pumps are fully described and illustrated in new bulletins just issued by the Dayton-Dowd Co., Quincy, Ill.

411. Full information regarding sewage pumps is given in publication 210, and a large number of sewage pump installations are illustrated and described in publication 193. The American Well Works, Aurora, Ill.

Sewage Screens

414. The Dorr Co., 247 Park Ave., N. Y., publishes Bulletin No. 6391, which describes the construction and operation of the Dorrco Mechanically-Cleaned Bar Screen.

415. Link-Belt Company, Philadelphia, shows in Book 642 its line of sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit; and Mechanical Aerators for activated sludge plants.

Sewer Cleaning Machines

416. Illustrated booklet describing Adjustable Turbine Sewer Cleaners, Self-Propelling Ferret Turbines, Drag Type Sewer Cleaners, Five Types of Sewer Rods, Conduit Rods, Windlasses, Sewer Braces, Sewer Cables. Turbine Sewer Machine Co., 5210 W. State St., Milwaukee, Wisc.

417. Turbine Sewer Machine Co., Inc., 5210 W. State St., Milwaukee, Wisc., has issued a 16-page *Price and Shipping Data Sheet* No. A-31. *These sheets give* a wealth of supplementary information to that found in our Standard Catalog or Bulletin 120-A. The Price and Data Sheets with or without catalog sent upon request.

418. "The Expanding Root Cutter and Sewer Cleaning Method" is the title of a recent 32 page booklet prepared by the Expanding Sewer Machine Co., Nappanee, Ind. Profusely illustrated, it gives full details as to methods and equipment needed.

Sludge Bed Glass Covers

420. Sludge Bed Glass Covers—"Super-Frame" Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds.

Storm Sewers

424. A 24-page catalog, profusely illustrated with actual installations under widely varying conditions, which lists the features that give superiority to flexible corrugated metal construction for storm sewer installations, can be obtained from Armco Culvert Mfrs. Association, Middletown, Ohio. As for the catalog No. 5.

423. The Toncan Culvert handbook, containing 56 pages of typical Toncan Culvert installations and much valuable data regarding the use of Toncan Copper Molybdenum Culverts for economical and lasting storm sewers, drainage information, etc., will be gladly sent free upon request. Address Toncan Culvert Mfrrs. Assn., Massillon, Ohio.

Treatment

425. Dorr Company, 247 Park Ave., New York, in its Sanitary Engineering bulletin describes the use of its equipment for treating municipal sewage, industrial wastes and water. Photos of numerous operating plants are shown as well as representative flow sheets illustrating the various methods of sewage treatment.

427. The Pacific Flush Tank Company, of Chicago and New York, publish eight separate catalogs on Sewer and Sewage Disposal Automatic Equipment, including pumps, Imhoff Tanks and Sewer Joint Compounds. These are of real value to the designer or operator of a treatment plant.

428. Advantages of Liquid Chlorine for disinfection given in booklet issued by the Electro Bleaching Gas Co., 9 East 41st St., New York.

429. Chlorine is being extensively used in the disinfection of sewage not only as a disfectant but as an aid to other purification processes. Wallace & Tiernan Co., Inc., Newark, N. J., have a publication, No. 42, on the chlorination of sewage, which will be sent to any address on request.

430. The Dorr Co., 247 Park Ave., N. Y., publishes Bulletin No. 6171, which describes the treatment of sewage with Dorr Traction Clarifier, an improved type of continuous sedimentation for use in water and sewage treatment plants.

432. The Dorr Company, 247 Park Ave., N. Y. C., publishes Bulletin No. 6491, which describes the construction and operation of the Dorr Detritor for continuously removing and washing the grit from sewage flows.

434. Automatic, continuous vacuum filters, producing a relatively dry cake of sludge in demand for fertilizer, are used by: Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C., write for literature, Oliver United Filters, Inc., Federal Reserve Bank Bldg., San Francisco, Calif.

Water Works Equipment

Activation and Aeration

465. A new booklet describing Norton Porous Mediums of bonded fused alumina (strong, chemically stable, uniformly permeable), the booklet will be of interest to all chemical and sanitary engineers. Issued by Norton Co., Worcester, Mass.

Couplings and Tees

485. A new booklet just issued by Mueller Company, Decatur, Ill., fully describes and illustrates the new line of Mueller Tapping Sleeves, Valves and Drilling Machines for water works officials.

505. "Mathews" Fire Hydrants. Gate Valves and other water works appurtenances. 16 pages, 7¾x10¾. R. D. Wood & Co., Philadelphia.

506. Hydrants, tapping apparatus, gate locks, valves and curb cocks described in a series of bulletins issued by A. P. Smith Mfg. Co., East Orange, N. J.

Jointing Materials

515. MINERALEAD for bell and spigot water mains, G-K Compound for vitrified clay sewers, also M-D Cut-Ins for making house connections, described in catalogue of Atlas Mineral Products Co., Mertztown, Pa.

Meters

520. "Niagara and American Water Meters are described in the 36-page catalog issued by Buffalo Meter Co., 2920 Main St., Buffalo, N. Y. Catalog describes the chromium-shell gear train, patented frost bottom, ultra-simple design and other exclusive features."

Meter Boxes

526. An illustrated catalog covering meter boxes and specialties such as gate valve housing, curb boxes, meter testers, melting furnaces, jointing materials, four-in-one pumps, has recently been published by the Hydraulic Equipment Co., Reading, Pa.

Pipe, Cast Iron

534. "Sand-Spun," Centrifugal cast iron pipe manufactured by R. D. Wood & Co., Philadelphia, is fully described in a valuable 16-page 6x9 booklet, containing also complete specifications of this pipe. No engineer or water works official should be without this booklet.

535. Cast Iron Pipe and Fittings, sizes 1¼ through 12 inches, either with or without Precaulked lead joints factory-made in the bells. Data book sent free. The McWane Cast Iron Pipe Co., Birmingham, Ala, and Provo, Utah.

536. "Weights and dimensions of Cast Iron Pipe and Fittings." A handy reference book for Municipalities and Contractors. 48 pages, 7¾x10¾. R. D. Wood & Co., Philadelphia.

539. U. S. Cast Iron Pipe Handbook contains useful tables and data for the Water Works man on pipe line construction. Issued by U. S. Cast Iron Pipe and Foundry Company, Burlington, N. J.

Pipe, Cement Lined

540. Steel or Wrought Iron Pipe lined with cement and special lead-lined joints, manufactured by the Cement Lined Pipe Co., of Lynn, Mass.

Pipe for Subdrainage

549. The benefits following the use of Armco perforated iron pipe for various municipal uses such as golf course, athletic field, and airport drainage; and its various applications in the construction and maintenance of highways and railroads are outlined in the 24-page illustrated catalog entitled, "Armco Perforated Iron Pipe." Catalog No. 4 is obtainable upon request from Armco Culvert Mfrs. Association, Middletown, Ohio.

Pumps, Waterworks

560. Centrifugal pumps for high or low service pumping for waterworks and filtration plants. Bulletins contain interesting installation photos, characteristic curves, etc. Dayton-Dowd Co. Mfrs. Centrifugal Pumps, Quincy, Ill.

Pumps

561. Double suction centrifugal pumps are described in Bulletin 197; multi-stage centrifugals in Bulletin 200; deep well turbines in Bulletin 211, and a number of municipal pump installations in Bulletin 178. These contain much valuable data. Free on request. The American Well Works, Aurora, Ill.

Pump Packing

575. "When Power Is Down," by the Sterling Engine Company, Buffalo, N. Y., gives recommendations of models for standby services for all power requirements.

Screens

576. Link-Belt Co., Chicago, Ill., has issued Book No. 1252, which describes their Water Screens and gives complete technical information about them.

Service Boxes

578. "Service Boxes with Stay-on Covers. No more broken covers. No more lost covers." (Booklet). The Central Foundry Company, 120 Lexington Avenue, New York, N. Y.

Swimming Pools

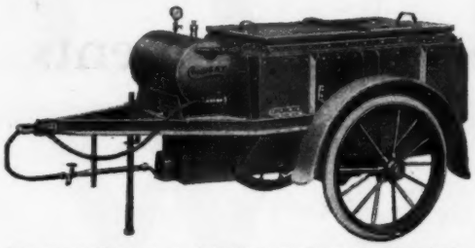
580. Wallace & Tiernan Co., Inc., Newark, N. J., have just published a new edition of technical publication, No. 41, dealing with the sterilization of swimming pools by liquid chlorine. Copy sent on request.

Tanks and Stand Pipes

582. A 50-page booklet issued by Pittsburgh-Des Moines Steel Co., 3479 Neville Island, Pittsburgh, Pa., on complete water works plants, elevated tanks, stand pipes and filtration plants built by them.

Tapping and Valve Machines

583. The A. P. Smith Company, of East Orange, N. J., furnish descriptive matter dealing with their many labor saving devices as the Smith tapping machine, valve inserting machine and pipe cutting machines.



We manufacture a full line of Tar and Asphalt Kettles, Oil Burning Kettles, Pouring Pots, Torches, Hand Spraying Attachments, etc. Send for our "Blue Book" illustrating our complete line.

CONNERY'S

Style "J" Oil Burning Kettle will guard any highway with economy and efficiency. Something easy to handle and quick to heat. Equipped with standard roller bearings, springs, improved oil burner and rubber tired wheels and heat guards if desired.
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South Bend Foundry Co.
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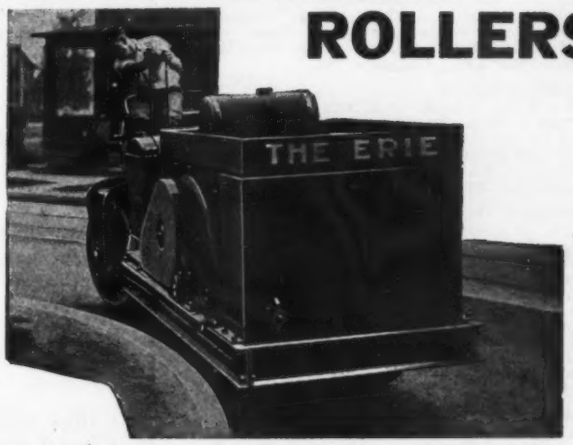
CUMMER TWO-FIRE HOT MIX ASPHALT PLANTS

The F. D. Cummer & Son Co.
Cleveland, Ohio

Pavements cost you less when rolled with ERIE ROLLERS



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- Uniform hardness from curb to curb
- Minimum of hand tamping
- Better factory service
- Greater flexibility for cross rolling
- Balanced weight, preventing sinking in or bridging
- Clear view for the operator
- Unequalled ease in steering

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Roller Specialists for 40 years.

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 83

Valves

585. Catalog covering our line of Bronze and Iron Valves for service on Steam, Water, Gas, Gasoline, Air and Oil lines furnished upon request. Also data on "Dart" Unions and Fittings. The Fairbanks Company, 393 Lafayette Street, New York, N. Y.

Miscellaneous

Airport Construction

595. Airports and Airways. A 20-page illustrated booklet by the Caterpillar Tractor Co., Peoria, Ill., describes the uses of tractors in building airports and handling planes.

597. "Getting on the Air Map With 'Caterpillar'," profusely illustrated with action pictures, describes the many uses of the tractor in building and maintaining airports better, quicker, cheaper. Caterpillar Traction Co., San Leandro, Calif., and Peoria, Ill.

Airport Drainage

599. The Toncan Culvert handbook, containing 56 pages of typical Toncan Culvert installations and much valuable data pertaining to the use of Toncan Perforated Iron Drains and Culverts for economical and permanent drainage of landing fields, will be sent free upon request. Address Toncan Culvert Mfrrs. Assn., Massillon, Ohio.

Asphalt Bridge Planking

601. The Philip Carey Company, Cincinnati, Ohio, has available a handsome booklet describing Elastite Asphalt Plank for Bridge Flooring—with specifications for use—liberally illustrated with photographs.

Chains and Speed Reducers

607. Link-Belt Co., Indianapolis, Ind., gives full description of its positive drives in books. No. 125 Silent Chain; No. 1257, Roller Chain; No. 815, Herringbone Speed Reducers; No. 1050, Promal Chains. Send for these positive power transmission books.

Community Advertising

610. Booklet showing various forms of publicity matter useful in arousing interest in the construction of small town water supplies. This matter is furnished free to Consulting Engineers and towns interested in waterworks construction by The Cast Iron Pipe Research Association, 566 Peoples Gas Bldg., Chicago, Ill.

Flexible Joints

611. Bulletin 204 containing 60 illustrations gives complete data regarding uses and specifications of Barco flexible joints for water works, sewage disposal plants, road contractors pipe lines, etc. Just issued by the Barco Mfg. Co., 1800 Winnemac Ave., Chicago, Ill.

Miscellaneous

618. Pipe Lines and the Caterpillar. In this 32-page booklet are pictured many uses of the Caterpillar Tractor, and ways in which they can be applied to the saving of men, money and minutes. The Caterpillar Tractor Co., Peoria, Ill.

Municipal Drainage Products

620. A complete line of drainage products which meets the modern municipal need for drainage materials that are quickly installed, safe, and dependable and economical in service is described in the new 24-page, illustrated catalog, "Armco Municipal Drainage Products." A request to Armco Culvert Mfrs. Association, Middletown, Ohio, for Catalog No. 9 will bring you this book free of obligation.

Rules

625. The Lufkin Rule Company, Saginaw, Mich.; New York; Windsor, Canada. Manufacturers of Measuring Tapes, Boxwood Rules, Spring Joint Rules, Straight and Folding Steel Rules, Fine Mechanics Tools and Aluminum Folding Rules. General Catalog No. 11.

Transits and Levels

630. A complete line of Transits and Levels particularly adapted for City, County and State work is fully described and illustrated in a new 64 page catalog just published by the Warren-Knight Co., 136 No. 12th St., Philadelphia, Pa.

Tree Moving

632. "Tree Moving," folder from the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill., shows and tells with action pictures and the letters of landscaping experts how to successfully move large trees.

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Printed by W.N.U., New York.